TACTICAL COMBAT FORCES OF THE UNITED STATES AIR FORCE: ISSUES AND ALTERNATIVES

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NOTES

Unless otherwise stated, all years referred to in this paper are fiscal years.

Details in the text, tables, and figures of this report may not add to the totals because of rounding.

All costs are expressed in current dollars of budget authority, using the Administration's February 1985 economic assumptions, unless otherwise noted.

PREFACE

In the past few years, the Congress has restrained spending for tactical aircraft in the Air Force. These funding decisions, and similar ones that could be debated in the future, will have important effects on the Air Force's ability to expand the size of its tactical air forces while simultaneously modernizing these forces and retiring older planes. Longer-term decisions about aircraft development will influence force size and composition through this century and into the next. This analysis by the Congressional Budget Office (CBO) presents the effects of the Administration's current tactical aircraft plans on cost and modernization. It also considers alternatives to the Administration's plans and discusses the effects of current plans for fighter development on future forces. The study was requested by the Defense Subcommittee of the Senate Appropriations Committee. In keeping with CBO's mandate to provide objective analysis, the study contains no recommendations.

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SUMMARY

For many years, in successive reports to the Congress, the Department of Defense (DoD) has expressed the intention to increase Air Force tactical forces. In addition to this expansion, DoD has begun to modernize these forces with new F-15 and F-16 fighter/aircraft while retiring older, F-4 fighters. Tactical air forces have the flexibility to perform a variety of missions and tasks. In a major European war, they would be employed primarily to assist U.S. and allied ground forces by attacking the enemy in the air and by bringing additional firepower to bear against enemy ground forces. The Administration contends that both expansion and modernization of the tactical forces are needed because the Warsaw Pact enjoys a more than two-to-one advantage over NATO in numbers of aircraft and because the Soviet Union has been steadily improving the capability of its aircraft compared with those of the United States.

The Defense Department's plans for tactical forces have generated debate in the Congress, largely because tactical aircraft are expensive to buy and to operate. Indeed, the Congress has altered previous plans. For the last four years, the Congress has reduced requests for purchases of the F-15, the more expensive of the two new aircraft now being procured.

ADMINISTRATION'S PLANS FOR THE TACTICAL AIR FORCES

Three major goals are embodied in the Administration's plans for the tactical forces over the next five fiscal years. They are:

- Build up the force structure from the current 36 wings to 40 wings by 1991 (a wing consists of 72 aircraft plus maintenance and training aircraft);
- Modernize the force with new versions of F-15 and F-16 aircraft; and
- Retire old F-4 aircraft at about 20 years of age.

To accomplish these goals, the Administration plans to procure 1,284 F-15 and F-16 aircraft from fiscal years 1986 through 1990. At the same time, however, the inventory will lose aircraft because of retirements of older planes, training accidents, and other factors. The Congressional Budget Office (CBO) developed a model to reflect probable changes in the inventory over the five-year period. The analysis suggests that the 40-wing goal could indeed be met by 1991 if the Air Force were willing to delay retirement of its F-4s until they are about 21 years old.

Improvements to Potential Capability

The Administration's program should substantially improve tactical force capability. According to another model used by CBO, by 1992--when all of the planes bought by the Administration's program should have been delivered--the force's potential capability would have improved by 32 percent over the 1985 level. (The model has important limitations, however, including some subjectivity and omission of certain factors, such as strategy, tactics, leadership, luck, and pilot performance; nonetheless, it provides a useful guide for comparing options.) Other indicators corroborate the model's predicted improvements. By 1992 the average age of the force inventory would be under 10 years of age, which the Air Force considers desirable, and 22 percent of the inventory would consist of the more capable F-15 aircraft (see the Summary Table).

Costs of the Plans

These improvements would, however, require continued real increases in the budgets for tactical air forces. The CBO has estimated that the direct costs of procuring and operating the tactical forces would be $100.1 billion in budget authority from 1986 through 1990. In 1985 tactical force costs were $16.4 billion. Thus, the DoD plans would require roughly a 2 percent real increase (that is, an increase above the rate of inflation) in each year after 1985.

This estimate could be low. It assumes that no real increase occurs in the costs of operating aircraft and that aircraft procurement costs decrease as production quantities increase. For the past 20 years, however, Air Force tactical operating and support (O&S) costs per aircraft have experienced real growth of about 3 percent annually; and, for the past five years, unit procurement costs for the F-15 and F-16 have experienced real increases of about 15 percent and 11 percent per year, respectively. Should either of

these trends continue, annual real growth in total funding would need to be about 7 percent to meet the Administration's goals.

ALTERNATIVE FORCES

Because it might be impossible to increase tactical air force budgets by 2 percent to 7 percent, CBO has considered several alternative force levels that suspend one or more of the Administration's goals in order to reduce costs (see the Summary Table).

Slow Modernization by Buying Fewer F-15s

In each of the last four years, both the Administration and the Congress have achieved budget savings by reducing procurement of the Air Force's

SUMMARY TABLE. EFFECTS OF THREE MAJOR OPTIONS ON ADMINISTRATION'S PLANS, FISCAL YEARS 1986 THROUGH 1990

Option	Five-Year Savings from Administration's Plan (In billions of dollars of budget authority)	Number of Wings by 1991	Potential Capability Increase Over 1985 (In percents) a/ b/	Average Age b/	Percent F-15s b/
Administration	---	40	32	9.7	22
Slow Modernization by Buying Fewer F-15s	3.5	40	28	10.1	20
Slow Modernization by Improving F-4s	11.0	40	28	11.1	15
Postpone Force Growth	6.8	36	21	9.8	21

SOURCE: Congressional Budget Office.

a. Based on a model used by CBO to quantify the potential capability of the planes which make up the inventories of each of these forces. Chapter III and Appendix B provide discussions of the model's assumptions and methodology.

b. Values shown reflect figures as of 1992. This year was chosen because by then all aircraft bought during the five-year period will have been delivered.

top-of-the-line fighter, the F-15, which costs $49 million per unit in 1985 dollars. This alternative would continue this practice. If F-15 procurement were kept at 36 per year, rather than increased to 60 per year as is currently planned by the Administration, savings would be $0.5 billion in budget authority in 1986 and $3.5 billion over the 1986-1990 period. A modest increase in the F-4 retirement age (to about 22 years) would enable the force to expand to 40 wings by 1991, even with fewer F-15 purchases.

Moreover, under this option, by 1992 the inventory would still be more capable than it now is in 1985, and only slightly older--at 10.1 years--than the age of 9.7 years under the Administration's program. Further, according to the model used by CBO, the 1992 force with fewer F-15s would still be 28 percent more capable than the inventory is in 1985, compared with a 32 percent improvement under the Administration's plan. It would, however, contain only 20 percent of F-15 aircraft, compared with 22 percent under the Administration's plan (see Summary Table).

This option is consistent with a modest emphasis on increasing total numbers of aircraft rather than increasing numbers of the most highly capable aircraft. Large numbers of aircraft would be useful if the United States had to fight simultaneous conflicts in different areas of the world and could be useful in the chaos of a battlefield, where maintenance of the most capable aircraft would be difficult.

Slow Modernization by Extending F-4 Service Life

If larger savings should be required, it would be possible to reduce aircraft procurement by extending the useful life of F-4 aircraft. In 1984 about 30 percent of the inventory--1,200 aircraft--were F-4s, the bulk of which were procured in the 1960s. The Air Force intends to retire F-4s when they reach about 20 years of age; however, the plane's airframe should last at least 30 years. The 20-year retirement age reflects the attempt to meet the anticipated capabilities of newer Soviet aircraft, such as the SU-27 Flanker and MIG-29 Fulcrum. These aircraft, which are expected to enter the Soviet forces in quantity in the next few years, could render the unmodified F-4 operationally obsolete before it is structurally worn out.

To minimize this problem, the Air Force could modernize its F-4s, perhaps along the lines recommended by the Air National Guard. The Guard has suggested that the F-4 be improved by upgrading electronics and adding fuel tanks to provide longer range.

If modernized F-4s were retained until 30 years of service, then all further F-15 purchases could be discontinued and the force could still be

expanded to 40 wings. Even after paying for modernization of the F-4s, this approach would save $11.0 billion over the next five years and $2.1 billion in 1986.

While the cost savings under this alternative are higher than under the previous option, the inventory produced by this alternative would still experience about the same improvement in potential capability--28 percent higher. With an average age of 11.1 years by 1992, this inventory, however, would be older than those of the Administration's program or the previous option. Furthermore, the share of F-15s in the inventory would drop to 15 percent (see Summary Table).

This option, like the last one, emphasizes increases in total numbers of aircraft rather than increases in the most capable aircraft. But this option goes much further, retaining F-4s in the force until they are 30 years old and discontinuing all further procurement of the F-15. This implies buying aircraft to replace older F-4s in about 10 years, whereas buying new aircraft now would postpone further replacements for about 20 years. But this option does reduce near-term costs substantially, while providing significant improvements in near-term capability.

No Force Growth

Unlike the first two alternatives, this third option emphasizes improvements in the most capable aircraft rather than in total numbers of aircraft. Expanding to 40 tactical fighter wings, rather than the current 36 wings, has been an Air Force goal for many years. If the goal were abandoned, it would be possible to save about $5.6 billion over the five-year period in procurement costs and an additional $1.2 billion in operating and support costs. Savings would be realized by buying fewer F-15 and F-16 aircraft and by operating fewer wings. This alternative would save about half the amount of its philosophical opposite, which would extend the F-4s service life and buy the larger force.

This option might be the Administration's implicit preference in the face of the fiscal constraints. Initially, this Administration planned to achieve 40 wings by 1986. But in each successive report to the Congress, the goal has slipped because of budget limitations.

This alternative would produce the smallest increase in potential capability of the three options considered. No growth in forces would produce a 21 percent increase in capability over 1985, making it the least attractive of the three options by this indicator. The smaller inventory

would, however, be as young (at 9.7 years) as that proposed by the Administration, and would contain almost as many F-15s, 21 percent of the force (see the Summary Table).

These three options pose clear near-term choices for the Administration and the Congress. If costs are to be reduced, it could be accomplished by slowing modernization--either by slowing F-15 procurement and modestly extending F-4 service lives or by discontinuing F-15 purchases altogether and substantially extending the service lives of an improved F-4. A different approach would reduce costs by abandoning plans to increase the number of wings. The choice depends on how much must be saved and on the decision about whether to emphasize increases in total numbers of aircraft or in numbers of the most capable aircraft.

Analysis in this study suggests that the Administration's apparent choice in the face of budget limits--postponing growth in numbers of wings--might not produce as capable a near-term force while saving much less than other approaches, such as growth in numbers of wings accompanied by extension in the service life of improved F-4s.

LONGER-TERM CONSEQUENCES OF TODAY'S DECISIONS--ADVANCED TACTICAL FIGHTER DEVELOPMENT

The Air Force is now developing a totally new aircraft for the 1990s--the advanced tactical fighter (ATF). This aircraft would exploit a group of new technologies and would be more capable in many ways than the aircraft now being procured. In particular, the Air Force would like the ATF to have enhanced avionics, supersonic cruise capability, stealth characteristics to make it less visible to enemy radar, short-take-off-and-landing capability, high reliability and maintainability, long flight ranges, and improved survivability for the aircraft and crew in environments contaminated by nuclear fallout or biological warfare materials.

The Air Force believes these added capabilities will be needed to meet the threat of improved enemy capability. By the mid-1990s, when the ATF could begin entering the U.S. inventory, the Soviet Union will probably have deployed in quantity two new aircraft believed to be highly capable fighters.

Although these enhanced capabilities might be needed to match Soviet quantitative and qualitative increases, the improvements probably will make the ATF very expensive. The level of expense could have a dramatic impact

on the size of the Air Force tactical fighter forces, another key element of total capability.

The CBO analysis suggests that it would be almost impossible to maintain the current 36 wing force in the next century--let alone expand it--if the Air Force experiences the same kind of cost growth in moving from the F-15 to the ATF as its most capable plane as it did in going from the F-4 to the F-15. Even after adjustment for inflation, "flyaway" costs per aircraft (that is, costs excluding spare parts and ground equipment) for the F-15 were about three times those of the F-4. Even if flyaway costs only double--as occurred between the F-4 and the lower-cost, less capable F-16--optimistic assumptions about other factors influencing the numbers of wings would be required to allow the Air Force to maintain the current 36 wings. Only if the Air Force could overcome historical precedents and hold ATF costs to 50 percent above F-15 levels--the approximate level of recent Air Force projections--would maintenance of the current force size be probable. Expansion above today's 36 wings would require optimistic assumptions about other factors.

Moreover, it is possible that this analysis overstates the numbers of wings that could be maintained. Because the ATF will not be in the Air Force in large numbers until the end of the century, the analysis rests on the long-run assumption of 3 percent annual real increases in the tactical aircraft budget, similar to the average of past increases in the gross national product. From 1964 through 1983, however, weapons systems budgets for Air Force fighter/attack aircraft increased an average of only 2 percent a year, after adjustment for inflation.

Expansion in numbers of wings, even with large growth in ATF costs, would be quite feasible if the Air Force were to receive 5 percent annual increases in tactical air funding during the next decade. But such increases are improbable in light of likely limits on growth in the total defense budget and competition for money that could restrain growth in the budget share accorded tactical aircraft.

Why worry about costs of a plane that will not be fielded until the mid-1990s? Fighters take a very long time to develop, and the ATF is already in the beginning development stages. It is scheduled soon to go through the first milestone in the development process--the decision to proceed with validation of the design concept. The further the plane moves into the development process, the more difficult it will be to make design changes. By the time the ATF could have a significant impact on the budget, many fundamental decisions that dictate future costs would have

already been made and the options available for savings would be limited. Therefore, it is not too early for the Congress to consider ATF costs and the concommitant future budgetary and force structure implications. It could, for example, require an annual report on ATF costs with the intention of limiting costs to current Air Force estimates.

CHAPTER I

INTRODUCTION

The tactical forces of the United States Air Force are composed of almost 4,000 aircraft, their support equipment, and the 98,000 people who directly operate and maintain them. In fiscal year 1985, funds for these forces amounted to $16.4 billion, or 16 percent of the total Air Force budget. The Department of Defense (DoD) relies on Air Force tactical air power--along with Navy tactical air power which is not discussed in this report--to augment the capabilities of U.S. ground forces in a conventional, or nonnuclear war. 1/ 2/ Tactical air forces defend ground forces from enemy air attack and attack enemy ground targets. Air power has the major advantages of rapid and flexible response and the ability to penetrate areas where time, distance, or geographical barriers limit the use of ground forces.

A large portion of these tactical air assets are either stationed at, or scheduled to deploy to, NATO bases in Western Europe in response to aggression by the Soviet Union and its allies in the Warsaw Pact. NATO relies on tactical air forces to provide critical extra fire power to offset numerical disadvantages on the ground, in addition to protecting NATO forces from Warsaw Pact air attacks. Because of the size and capability of the Warsaw Pact conventional forces, they present the greatest tactical threat to U.S. interests. Although the probability of a war in Central Europe between NATO and the Warsaw Pact is limited, the incalcuable costs of losing such a war cause perceptions about the size and nature of this threat to shape the composition of U.S. forces.

Projections of the size and capability of Warsaw Pact forces are the subject of much debate within DoD and the U.S. intelligence community. It is difficult to determine exactly how many aircraft the Warsaw Pact currently has, much less project the Pact's plans for expansion. Estimates of the capability of Soviet aircraft, which supply both non-Soviet Warsaw Pact nations and the Soviet Union, are equally difficult to assess unless the U.S. actually has one of the aircraft to fly and test. In addition, since the USSR

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1. Many tactical aircraft, however, also can deliver nuclear weapons.

2. Congressional Budget Office, *Combat Aircraft Plans in the Department of the Navy: Key Issues*, Staff Working Paper (March 1985).

is a closed society, it is difficult to predict Soviet strategy with any degree of certainty. Thus much development of U.S. strategy occurs with high levels of uncertainty. Doubt about the level of the threat inevitably leads to doubt about the level of U.S. defenses that are needed.

TACTICAL AIR FORCE ISSUES

How best to counter this uncertain threat? The choice of whether to buy relatively large numbers of less capable aircraft or smaller numbers of more capable (and more expensive) aircraft has been particularly contentious. In general, the Air Force has chosen quality in the so-called "quantity-versus-quality" debate, though the service has also gradually increased its numbers of forces over the last decade and hopes to increase them further during the late 1980s and early 1990s. Quantity and quality goals conflict because, with a fixed pool of assets, developing and procuring relatively more capable and expensive aircraft limits resources that could be devoted to force growth. The Air Force apparently believes that, in the face of Soviet willingness to produce large numbers of planes, it must counter probable numerical inferiority by having aircraft that are, plane for plane, more capable. Reliance on high capability is also consistent with the faith the United States has historically placed in technology.

Critics doubt Air Force claims for high capability planes, however--particularly claims of performance from the enhanced avionics and the advanced missiles that such planes carry. More complex aircraft might be more difficult to maintain in the confusion of battle and thus could prove less capable. They might also provide capabilities--such as the ability to fire missiles at long range--that might not be useful in a complex and confused air war. 3/

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3. A good deal of debate in the tactical air arena centers around the efficacy of the medium-range radar missile. If such missiles prove to be effective, they provide the leverage of first shot against the enemy and might reduce the numbers of aircraft necessary to be effective. In the past, radar missiles have produced disappointing results, although improvements to the missiles have, according to the Air Force, greatly increased performance. Other concerns raised by critics include the missile's susceptibility to countermeasures such as jamming and deception techniques and the fact that an active radar on the aircraft firing the missile can warn enemy aircraft and deprive the attacking force of surprise, a factor believed by many pilots to be the single most important criterion for success in air combat. Questions still remain about the impact of the rules of engagement on missile effectiveness. Critics have argued that most shots will have to be taken only after there has been visual identification of the opposing aircraft, thus obviating any advantages of the radar missile. The Air Force argues that this problem has in part been solved by devices that can distinguish between friendly and unfriendly aircraft. Perceptions about how air combat will be pursued have a direct impact upon what kind and what quantity of aircraft the Air Force should procure.

No study can resolve these fundamental disagreements on analytic grounds. 4/ This study does, however, present options that are consistent with various views of the issues.

Another subject of debate is how long to keep older aircraft in the inventory. The Air Force would retire aircraft after 20 years for two major reasons. First, the Air Force believes that after about 20 years, development of enemy aircraft makes U.S. aircraft obsolete to counter the threat. This is really the quantity-versus-quality debate again, since keeping older aircraft longer provides--for the same investment dollars--a larger force but one that might be less capable on a per plane basis. Options in this study address the Air Force's preferred approach of retiring aircraft at 20 years and buying newer, more capable planes, but they also discuss keeping older aircraft, sometimes modifying them to improve their capability.

The second reason the Air Force wants to retire aircraft at around 20 years is its contention that operating and support costs of aircraft increase dramatically at that age, as does the likelihood of peacetime accidents because of wear and tear on parts. The Air Force, however, has not supplied CBO with any firm empirical evidence to support this contention. Indeed its own estimate of when its older aircraft would become structurally unsound--the "engineering service life"--exceeds 20 years for many older types of aircraft. It might seem intuitively obvious that the Air Force is correct on this issue. Any automobile owner knows that an old car costs more to maintain and experiences increasing problems. But several factors could delay this result in Air Force aircraft, at least beyond 20 years. For one, aircraft typically receive maintenance throughout their service lives far in excess of that provided by even the most conscientious car owner. Additionally, as aircraft age the service typically moves them from missions that place a great deal of stress on them (like counterair) to less taxing missions (many air-to-surface missions). Also aircraft are moved from the active to the reserve elements, whose maintenance personnel and pilots typically have more experience than those in the active forces. Any of these factors might explain, in part, the lack of data to support the need for aircraft retirement at 20 years of age.

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4. See James Fallows, *National Defense* (New York: Randon House, 1981) for an example of the criticisms about quality. For the views of proponents of qualitative improvements, see an *Air University Review* critique of Fallows' book "Military Reform: Past and Present," *Air University Review* (July-August 1981), pp. 101-108. For a discussion of the issues in the debate, of which quality versus quantity is only one, and for a series of articles by participants in the debate, see Asa Clark and others, eds., *The Defense Reform Debate: Issues and Analysis* (Baltimore: Johns Hopkins University Press, 1984).

As with the quality versus quantity issue, this study cannot fully resolve the issue of appropriate retirement age. But the study does present options that keep Air Force aircraft beyond 20 years. In light of the lack of firm data arguing for retirement at 20, such options at least deserve careful scrutiny.

What kinds of aircraft to buy, and how long to keep them, are the fundamental issues that shape the tactical aircraft debate and the options in later chapters of this study. The remainder of this chapter provides detail on the aircraft involved in the debate, including the missions they perform and their individual characteristics.

AIRCRAFT IN THE TACTICAL AIR FORCES

The Air Force currently has 36 tactical air wings of combat aircraft (a wing typically consists of three squadrons of 24 combat aircraft, plus 28 maintenance and training aircraft for each wing) and would like to build to 40 wings by 1991. An inventory of almost 4,000 aircraft support the current force structure. About 75 percent of this inventory is based in the continental United States with the Tactical Air Command (TAC--43 percent), the reserve elements of the Air National Guard (25 percent), or the Air Force Reserve (5 percent). Seventeen percent of the inventory and the bulk of the forward deployed forces are located in Europe, reflecting the perceptions about the threat described above. The Pacific command has about 250 aircraft, or 6 percent of the total. Further reflecting the priority given to Central Europe, the Air Force has a goal of augmenting forces in Europe with 60 squadrons from the continental United States within the first 10 days of a conflict.

Tactical Air Force Missions

Tactical aircraft have three major missions: counterair, close air support, and interdiction (see Table 1). In general, the Air Force tends to give highest priority to the counterair mission because gaining and maintaining control of the air is the first consideration in employing tactical air forces. During the earliest stages of war, the Warsaw Pact is expected to launch massive air attacks against NATO targets to reduce the capabilities of NATO forces. Targets would include NATO centers for command and control, NATO air fields, and NATO theater nuclear capabilities. NATO tactical aircraft would attempt to counter such attacks by shooting down these enemy aircraft either from long ranges with radar missiles or from shorter ranges with infrared missiles and guns. Counterair would continue to be a high priority mission until enemy aircraft have been reduced to a relatively

TABLE 1. TACTICAL AIR FORCE FIGHTER/ATTACK AIRCRAFT

Aircraft	First Entered Force in Bulk b/	Approximate Quantity in Inventory in 1984 c/	Primary Mission(s) a/				Procurement Unit Cost d/
			Air-to-Surface			Air-to-Air	
			Close Air Support	Battlefield Interdiction	Deep Interdiction	Counterair	
A-7	Late 1960s	380	X	X	--	--	--
A-10	Late 1970s	690	X	--	--	--	--
F-4	Mid-1960s	1,160	X	X	--	X	--
F-111	Late 1960s	320	--	--	X	--	--
F-15	Mid-1970s	660	--	--	--	X	49
F-16	Early 1980s	740	X	X	--	X	22
F-15E	Late 1980s	0	--	X	X	X	--
F-16F	Early 1990s	0	X	X	--	X	--
Advanced Tactical Fighter	Mid-1990s	0	--	--	--	X	--

SOURCES: Contained in the following footnotes.

a. Air Force data.
b. Jane's *All the World's Aircraft* (various years).
c. Congressional Budget Office estimate from Air Force data.
d. For fiscal year 1985 from Air Force Congressional Data Sheets submitted with Fiscal Year 1986 Defense Budget.

minor threat. In the early stages of a war, it is likely that NATO would use as many aircraft for the counterair mission as could be spared, depending on the situation on the ground. As Warsaw Pact air forces are more numerous than NATO's, though somewhat less capable, this mission would probably continue to be important long after the first stages of a central European war.

Interdiction and close air support are the two major attack missions of the tactical air forces that directly support friendly ground forces. In the interdiction mission, aircraft attack previously identified targets or targets of opportunity in an attempt to divert or to destroy an enemy's military potential before it can be brought to bear against friendly forces. The interdiction mission can be performed against targets in a position to have an immediate effect on friendly troops--the so-called "battlefield interdiction mission"--or it can involve targets deep behind enemy lines. The main difference between deep interdiction and battlefield air interdiction is that the latter requires coordination with the ground component commander during planning.

In recent years, the deep interdiction mission has received increasing emphasis from the Air Force, in part because of the increased capability of newer Soviet aircraft (Fencer, Flogger J, and Backfire) to attack NATO main operating bases. The airfields where these Soviet aircraft are based thus become important targets. (Airfield attack can also reasonably be viewed as a part of the counterair mission as it is indirectly attacking aircraft.) Other major deep interdiction targets are Pact follow-on ground forces and geographical choke points such as bridges and railway hubs. The broad intent of an air interdiction campaign against these targets would be to prevent follow-on Pact armies and fronts from being used quickly enough to overwhelm NATO defenses.

Close air support, the second attack mission, involves engaging enemy ground forces that are an immediate threat to or are already engaged in combat with friendly forces. The difference between battlefield interdiction and close air support is the degree of coordination between air and ground forces. A high degree of coordination is necessary to avoid NATO aircraft firing on their own forces or being themselves fired upon in the confusion of battle. If coordinated properly, however, close air support can be an effective way to provide vital fire support in the rapidly changing forward battle area.

The Aircraft of the Tactical Forces

Tactical aircraft designs reflect perceptions about the relative importance of the missions. Six kinds of aircraft make up the 4,000 planes in the 1984 tactical aircraft inventory.

Air-to-Surface Aircraft. Three aircraft--the A-7, A-10, and F-111--are devoted exclusively to attacking surface targets.

A-7. Now used in Air Force combat units only in the Air National Guard, the A-7 was originally designed as a Navy attack aircraft. Its primary mission is battlefield interdiction, although it is capable of performing close air support. It is a single-seat, single engine, subsonic plane. The A-7 was last procured when a two-seat trainer version, the A-7K, was bought in fiscal years 1979 to 1981, but the bulk of the Guard's A-7s were bought in the early 1970s.

A-10. The A-10 was developed specifically for the close air support mission. It is heavily armored and incorporates many features to enhance its survivability in the high threat area over the battlefield. For example, its armor includes a so-called titanium "bathtub" that protects the pilot from ground fire and it has triply redundant aircraft control systems. 5/ The subsonic A-10 is also capable of loitering for extended periods and operating out of austere airfields to increase its responsiveness to Army requirements. The aircraft has a 30 mm gun for attacking tanks and can carry up to 16,000 pounds of bombs and missiles. A-10s were last bought in 1982 and the bulk of the inventory is about five years old.

F-111. Last of the aircraft devoted exclusively to surface attack is the F-111. When introduced in the early 1960s, the F-111 was expected to serve the Air Force, Navy, and Marine Corps. As conflicting design requirements raised costs and complexity, however, the plane was procured only for the Air Force. Four tactical versions of the F-111 were produced and a strategic FB-111 was developed for the Strategic Air Command. 6/ The F-111, with its movable or "variable geometry" wing intended to optimize its aerodynamic shape under different flight conditions, is a very sophisticated aircraft. The two-seat, twin engine, supersonic plane is the only aircraft in the Air Force tactical inventory with the avionics to fly long ranges at low levels and in bad weather. It can carry up to 24,000 pounds of munitions, making it the heaviest bomber in the tactical inventory. 7/ The average age of the current inventory of F-111s is about 14 years; however,

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5. Sources for many of the data presented here on aircraft are Department of the Air Force and Jane's *All the World's Aircraft*, various editions.

6. Originally the Strategic Air Command expected to procure 210 FB-111s but the eventual total procurement was 76.

7. The majority of the F-111s in the tactical inventory are not, however, capable of self-employing precision-guided munitions (surface attack munitions which are more accurate).

the Air Force indicates that they will remain in the active force well beyond the typical 20 year life span because of their unique capabilities.

The F-15, F-16, F-4, and New Developments. While the above three aircraft are part of the current force structure, forming about 35 percent of the total inventory, three other aircraft--the F-15, F-16, and F-4--are apt to be more relevant to future debates on Air Force tactical forces. Hence, they are the focus of this paper.

Because they are expensive--both individually and in the aggregate--Air Force tactical aircraft have regularly played an important role in the defense budget debate. The last few years have been no exception. Probably in response to Congressional pressure, the Administration has pared back its fiscal year 1986 request for F-15 and F-16 aircraft to a total of 228, compared to the 276 it planned to request in 1985 plans. This cutback reduced the fiscal year 1986 request by $1.2 billion. Moreover, the debate over funds for Air Force tactical forces seems likely to continue over the next few years in the face of continued Congressional efforts to hold down the growth in defense spending.

Most of the decisions facing the Congress today involve aircraft whose designs and costs were largely determined many years ago. Similarly, tactical fighter choices in the 1990s will be heavily influenced by the Advanced Tactical Fighter (ATF) now being developed. Should Air Force desires for capability increases drive the cost of this plane up, future trade-offs between numbers and more capable aircraft will be more difficult. Decisions to be made by the Congress and the Administration over the next few years will greatly influence the cost of the ATF, even though the plane will not enter the inventory until the mid-1990s or later.

F-15. The F-15 is currently the premier so-called "air superiority" aircraft in the tactical air forces. A single-seat, two engine, supersonic aircraft, its primary mission is to gain and maintain sufficient control of the air to allow friendly air forces to perform their missions while denying similar freedom of action to the enemy.

The F-15 capabilities include its look-down/shoot-down radar (allowing it to filter out ground clutter and detect low flying enemy aircraft) and its ability to fire the Air Force's current medium-range, air-to-air missile. Because this missile--the AIM-7--is radar guided and fired from beyond visual range, the F-15 is expected to attack enemy aircraft before the enemy can engage it. The Air Force considers the F-15 to be the most capable combat aircraft currently being bought for the tactical force. Four models of the

aircraft have been procured. The C and D models offer improved avionics and increased fuel capacity over the earlier A and B models. 8/ While the F-15 is a very capable airplane, it is also very expensive--costing $49 million per plane in fiscal year 1985. The Air Force has received funds to produce 834 F-15s through 1985, and expects to continue production of the F-15 into the 1990s, though most of these will incorporate design enhancements, as discussed later in this chapter.

F-16. The second of the two aircraft still being procured for the tactical forces is the F-16. The F-16 was developed in the late 1970s when the Air Force determined that the F-15 was too expensive to procure in the quantity desired. A comparatively small aircraft, the F-16 is considered a "swing-role" aircraft, performing both air-to-air and air-to-surface missions. It lacks the range to perform the deep interdiction mission, however, and the advanced avionics necessary to operate at night or in bad weather. Nonetheless, the F-16 is capable of performing the surface attack missions of battlefield interdiction and close air support.

In the air-to-air arena, the F-16 has a shorter-range radar than the F-15, and its small size might make it difficult for it to carry the medium-range, radar-guided missile, the AIM-7. It is thus not currently capable of performing the air superiority mission of striking "beyond visual range" (BVR). But, the F-16 can be modified to carry the AIM-7, and the Air Force might indeed perform this modification. The plane is also scheduled to receive the advanced medium-range, air-to-air missile (AMRAAM) if and when that missile is delivered. 9/ Until one of these events occur, the F-16 will not be able to perform the BVR mission. Because of its maneuverability, the F-16 is very effective at close-in fighting, or "dogfighting," the so-called "within visual range" (WVR) mission. Its small size also makes it less visible to enemy radar than larger aircraft. Four models of the F-16 have been developed with the C and D models offering improved avionics over the A and B models. The Air Force has received funds to produce 1,139 F-16s through 1985 and plans to continue

8. Fuel capacity, engine efficiency, and drag determine the range of the aircraft. In the deep interdiction mission, range is important because the targets are located far behind enemy lines.

9. Production of AMRAAM was to begin in 1985 but cost and production problems have placed the program's continuation at risk. If the missile actually is produced, the Air Force is projecting that it will have a better capability than current AIM-7s in that it will contain an active seeker that will enable the missile to pursue its own flight path to the enemy aircraft while the launching aircraft pursues other targets, thus enabling an AMRAAM equipped plane to attack more than one enemy aircraft simultaneously. AMRAAM is also supposed to have a longer range and be faster than the AIM-7.

procurement well into the 1990s. Also, the F-16 has been popular with other countries, having been bought by 12 nations, more than any other current generation U.S. fighter.

F-4. The F-4 is a two-seat, twin engine, supersonic aircraft capable of performing both air-to-air and air-to-ground missions. Besides the F-15, the F-4 is the only other aircraft in the Air Force inventory currently capable of carrying the AIM-7. Originally designed for the Navy, which received its first production F-4 in 1960, the Air Force began procurement of the F-4 in 1962 at the direction of the Secretary of Defense. Eventually the Air Force procured five models of the aircraft, of which about 2,300 were combat aircraft and 500 were reconnaissance planes. Of the combat aircraft, 1,160 are still in the Air Force inventory. Based on Air Force plans for a service life of 20 years, many of these will become obsolete in the late 1980s. Obsolescence is a problem abroad as well since 11 other nations use the F-4.

These six aircraft will form the Air Force tactical force structure through the 1980s and into the mid-1990s.

Modifications to Existing Aircraft

During the life of any particular aircraft, the Air Force typically produces several different models. In addition, enhancements that do not result in model changes occur on an on-going basis. Modifications can be minor, such as the replacement of some component with a more advanced version, or major, for instance, dramatic airframe changes. Some believe that this is a very cost-effective way to modernize the fleet. 10/ As earlier discussion indicates, development in current generation aircraft has proven no exception to this trend, with the introduction of C and D models of both the F-15 and F-16. The Air Force plans two more major model changes to these aircraft in this decade.

Modifications also are used to allow existing aircraft to accomplish new missions. In 1981 the Air Force announced plans to procure a new long-

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10. See, for example, Frederick Biery and Mark Lorell, *Preplanned Product Improvement and Other Modification Strategies: Lessons From Past Aircraft Modification Programs* (prepared for the United States Air Force by the Rand Corporation, December 1981); William L. Stanley and Michael D. Miller, *Measuring Technological Change in Jet Fighter Aircraft* (prepared for the United States Air Force by the Rand Corporation, September 1979); and Ellen A. Cherniavsky and Edward T. Timperlake, *TACAIR Performance/Cost Analysis: Trends Over Time* (prepared for the Director, Net Assessment, Office of the Secretary of Defense by The Analytic Sciences Corporation, September 18, 1981).

range, swing-role aircraft to supplement the small and aging fleet of F-111s in the deep interdiction mission. 11/ At that point, two aircraft manufacturers announced modifications to existing aircraft that would meet these specifications. McDonnell Douglas Corporation announced development of an F-15 "strike eagle" aircraft (eventually designated the F-15E), a modified F-15 with improved range and ability to perform ground attacks during bad weather. Shortly thereafter, General Dynamics Corporation proposed an enhanced version of the F-16, named the F-16XL. At Congress's direction, the Air Force conducted a competition between the two aircraft. The winner of the competition was the F-15E and the Air Force plans to procure about 400 of them. It is probable, however, that the F-16XL will also be developed (designated the F-16F), with initial procurement scheduled in 1989. Enhancements to produce the F-16F will be primarily directed at its air-to-surface role, and might include a major change to the airframe to enlarge the F-16's internal fuel storage and increase its range. Both aircraft are intended to enhance Air Force capabilities in the deep interdiction mission.

New Development

Thus these six aircraft--the F-15, F-16, and F-4, plus the three air-to-ground aircraft--and their derivatives will form the Air Force tactical force structure through the 1980s and into the middle 1990s. Press reports indicate that the Air Force might be producing a "stealthy" attack aircraft--possibly designated the F-19--which would be designed to avoid enemy radar and would augment the surface attack capabilities of these forces. The Department of Defense has not provided details about the plane--indeed it has not even confirmed its existence. 12/

By the 1990s, the Air Force projects that the threat--in terms both of Soviet aircraft and Soviet air defense systems--will be so capable and numerous that, even with modifications, today's U.S. aircraft will be obso-

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11. *Department of Defense Authorization for Appropriation for Fiscal Year 1982*, Hearings before the Tactical Warfare Subcommittee of the Senate Armed Services Committee, 97:1 (1981), pt. 3, p. 1273.

12. "New Stealth Fighter Deal Alleged," *Baltimore News American*, October 15, 1984 and Bill Sweetman, "Stealth," *International Defense Review*, vol. 2 (1984), pp. 7-12 are two examples of articles about the new aircraft, although it has been widely mentioned in the industry press. The first article indicates that the plane is to be produced by Lockheed and will be in production soon with 300 to 400 aircraft to be produced. DoD has refused to confirm or deny the plane's existence.

lete. The Air Force is particularly concerned about the Soviet acquisition of aircraft with so-called look-down/shoot-down radars that will deny Air Force surface attack aircraft the present safety afforded by low-level flight. The Air Force believes that their fighters will need to be able to destroy these new aircraft behind Soviet lines. It also hypothesizes that the USSR will produce a new generation of aircraft that will be more capable than today's U.S. aircraft. As a result, the Air Force is planning development of a totally new aircraft--currently called the Advanced Tactical Fighter (ATF)--aimed at providing dramatic increases in capability over existing fighter aircraft. The emphasis is on enhanced avionics, supersonic cruise capability, stealth characteristics, short-take-off-and-landing capability, high reliability and maintainability, long flight ranges, and improved survivability for the aircraft and crew in a contaminated environment. Because these capabilities all exceed those found in current fighters, it seems reasonable that the ATF could be a very expensive aircraft.

CHAPTER II

ADMINISTRATION'S PLANS FOR TACTICAL AIR FORCES

During this decade, the Air Force plans to buy new F-15s and F-16s and retire older F-4s while also increasing its requirements. This chapter compares aircraft available to those required under these plans and finds that--with minor exceptions--the Air Force will have enough aircraft to meet its projected requirements. Moreover, Air Force plans will entail increases of less than 3 percent a year in real budget authority for tactical forces. Such increases could be affordable, considering last year's Congressional plans that called for increases in total defense budget authority of about 5 percent a year, at least through fiscal year 1987. Nonetheless, many programs will be competing for dollars in this period. Also, more recent Congressional decisions limit defense growth to less than 5 percent a year. Thus the Congress may wish to consider alternatives to the current program (see Chapter III).

AVAILABLE AIRCRAFT

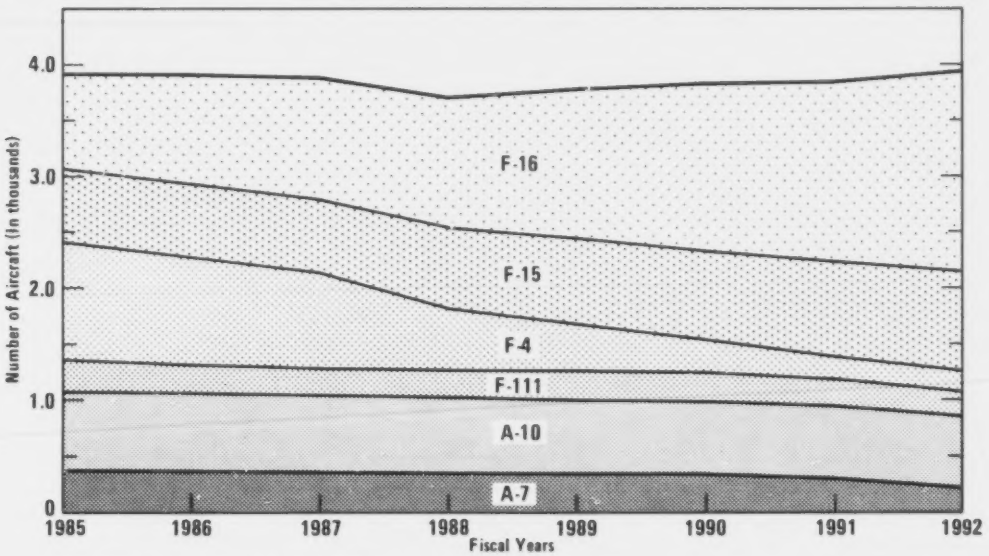
Under Administration plans, CBO estimates the Air Force's current level of about 4,000 tactical aircraft will remain relatively constant until the early 1990s and then begin to rise.

Inventory of Aircraft

Figure 1 shows the impact on the Air Force inventory of the retirement of aging aircraft and their replacement by new F-15s and F-16s. The large fleet of F-4s, bought primarily during the Vietnam War years, would be retired in quantity during the last half of the 1980s. These retirements would hold inventory levels fairly constant--even decreasing the level slightly in fiscal years 1987 and 1988. Deliveries of newly procured F-15s and F-16s would, however, steadily increase during this period until, by 1990, the Air Force would begin to receive deliveries of 276 aircraft per year. Thus, in the late 1980s and early 1990s, inventory levels would begin to rise as higher deliveries combine with a tapering off of F-4 retirements. Retirement of F-4s and their replacement also mean that, by 1988, more than half of the inventory would be composed of F-15s and F-16s.

Three key assumptions underlie these findings. First, the projection assumes that the Administration carries out its plan, expressed in the fiscal year 1986 budget, to buy 1,284 F-15s and F-16s in fiscal years 1986-1990 (see Table 2). Second, most aircraft are assumed to be retired at about 20 years of age as planned by the Air Force. 1/ (Chapter III considers alternatives to these Administration plans for procurement and retirement.) Third, because this paper focuses on tactical aircraft issues, this projection and the remainder of data in the main body of the paper exclude aircraft destined for strategic air defense--that is, defense of the United States against attacks by Soviet strategic bombers. Thus, procurements of F-15 and F-16 aircraft intended to maintain and modernize the 15 squadrons of strategic air defense interceptors were deleted from the inventories used in the main body of this report. Appendix A provides a discussion of the impact on the tactical forces of slowing the strategic air defense modernization.

Figure 1.
Tactical Aircraft Inventory (Current Administration Plans)



SOURCE: Congressional Budget Office estimates from Air Force data.

1. According to Air Force plans, the F-111 aircraft are retained in the force structure through this century, retiring them at 30 years of age.

Projections of future inventories depend not only on planned procurement and retirement but also on detailed assumptions, for example, the number of peacetime losses of aircraft through crashes or ground damage. Appendix B describes the method used to make these projections.

Age of the Inventory

Maintaining this substantial inventory of aircraft will be a challenge because of the age distribution of the fleet. The Air Force has a goal of keeping the average age of its fleet at about 10 years--which implies retirement of tactical aircraft after 20 years of service. At least for the last 10 years, the average age of the total fighter/attack aircraft inventory has not exceeded 10 years. If aircraft were equally distributed across the age spectrum, the Air Force estimates that it would have to procure about 260

TABLE 2. ADMINISTRATION'S PLAN FOR F-15 AND F-16 PROCUREMENT, AS OF FEBRUARY 1985 a/
(By fiscal year, in number of planes)

Plane	1986	1987	1988	1989	1990	Total 1986-1990
F-15C/D	40	0	0	0	0	40
F-15E	8	48	60	60	60	236
F-16C/D/F	180	180	216	216	216	1,008
Total	228	228	276	276	276	1,284

SOURCE: *Budget of the United States Government 1986*

a. February 1985 plans call for a force goal of 40 wings by 1991.

aircraft per year to maintain an average age of 10 years or less to achieve a 40-wing force. 2/

Annual procurement needs are likely to be higher than 260 in the next few years, however, because of the age composition of the Air Force inventory as of 1984 (see Figure 2). 3/ Almost half that inventory is currently 10 years of age or older, and was primarily procured in the 1960s during the Vietnam War. These aircraft would have to be replaced entirely by the mid-1990s, and in large numbers by the late 1980s, if the Air Force holds firmly to its goal of an average age inventory of 10 years.

This pattern reflects past procurement policies. After the large number of aircraft was acquired during the Vietnam years, there was a decrease in procurement, reflecting both reduced defense spending and a transition in procurement from F-4s to F-15s and from A-7s to A-10s (see Figure 3). Because the F-15 turned out to be a relatively expensive aircraft, thus, among other factors, limiting the number that could be purchased, it was not until F-16 deliveries began that the next large wedge of aircraft entered the inventory. At the same time that the F-16s were reaching quantity procurement, the A-10s were at a mature production rate. Thus fiscal years 1978 through 1980 were bumper ones for Air Force tactical aircraft procurement, with totals well over 300 annually. The early 1980s reflect a reduction in aircraft procurement as purchases of the relatively inexpensive A-10 were completed and F-15 and F-16 acquisitions were reduced.

Over the 20 year period between 1964 and 1983, average annual aircraft procurement has been 274; in the 10 years between 1974 and 1983

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2. The Air Force uses the following formula to derive these numbers:

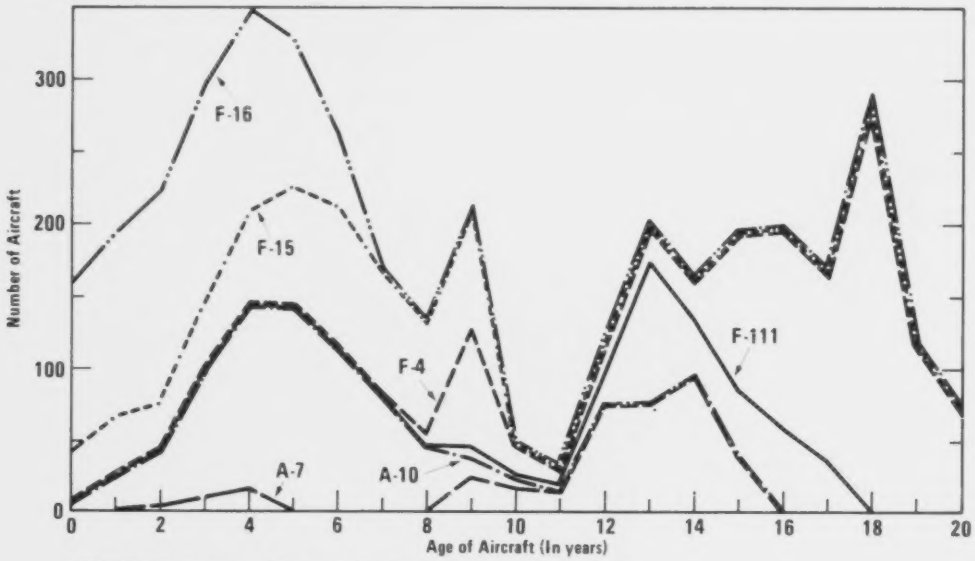
$$\text{Annual aircraft procurement requirement} = \frac{(\#\text{Wings}-40) \times (130 \text{ aircraft})}{(2) \times (\text{Average Age})} = 260$$

130 aircraft is based on:

Combat	72
Back-up	28
Total	100
Attrition and other losses	30
	130

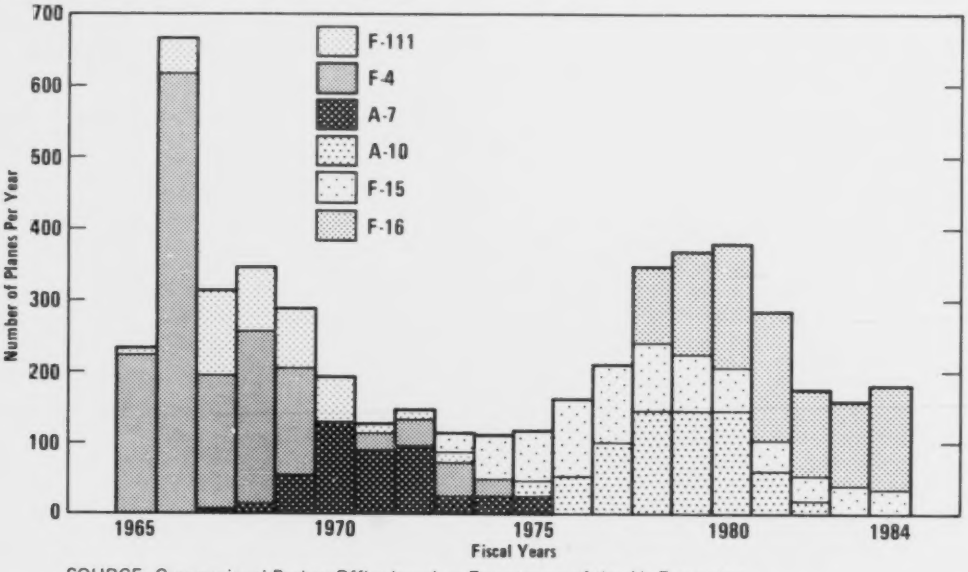
3. Some specific assumptions influence results in this figure. The F-4 aircraft currently in five air defense interceptor squadrons were deleted. As those aircraft are generally older F-4s, their deletion reduces the F-4 aircraft that are 17 through 20 years old.

Figure 2.
Age of Tactical Aircraft, Fiscal Year 1985



SOURCE: Congressional Budget Office estimates from Air Force data.

Figure 3.
Historical Aircraft Procurement



SOURCE: Congressional Budget Office based on Department of the Air Force data.

the level dropped to 240. These patterns are highly uneven, with large purchases in the middle of various procurement programs. In the Air Force Tactical Fighter Roadmap, a briefing assembled by the Air Force to describe its tactical goals for procurement, development, and force increases, the Air Force attempts to stabilize production patterns through the mid-1990s. 4/ By 1988 the Administration plans to buy 276 aircraft per year--a bit over the level of 260 aircraft needed to maintain 40 tactical fighter wings. The annual purchase of 276 would be above the average for the last 10 years, but somewhat below the heavy aircraft procurement years of the late 1970s.

AIRCRAFT REQUIREMENTS

The Air Force plans to increase its current force requirements from 36 wing "equivalents" to 40 wing "equivalents" by fiscal year 1991. A notional tactical air wing contains 72 combat aircraft in three squadrons of 24 aircraft each. Because the actual number of combat aircraft can vary among operational squadrons, the Air Force uses a wing equivalent to describe force size. This is derived by dividing the total number of combat aircraft by 72. In addition to the 72 combat aircraft, 28 are required per wing as back-ups. (Hereafter, a wing in this paper refers to a wing equivalent.)

Justifications for the Increase

The Administration justifies the need for the increased number of wings based on the growth in Soviet and Warsaw Pact capability and concern about Air Force ability to meet commitments worldwide. Soviet "frontal" aviation aircraft--that is, the Soviet forces most equivalent to the U.S. tactical air forces discussed in this paper--have outnumbered U.S. aircraft for many years (see Table 3). Recently, that Soviet advantage has increased because the number of Soviet aircraft has increased sharply, from almost 4,400 aircraft in 1980 to almost 5,300 in 1984. Some of this shift could represent reassignments of aircraft from other Soviet commands to the frontal aviation category, but even growth from reassignments suggests an increase in the threat to U.S. forces in Europe during the early days of a conventional war. These findings are based on numbers from the International Institute

4. For an unclassified discussion of this briefing, see Lt. Gen. Robert D. Russ, USAF, "The Fighter Roadmap," *Air Force Magazine* (June 1984), pp. 60-63. The procurement figures in this discussion have, however, been superseded by the fiscal year 1986 budget

TABLE 3. SOVIET FIGHTER/ATTACK AIRCRAFT INVENTORY
(By fiscal year, in number of planes) a/

Aircraft	1980-1981	1981-1982	1982-1983	1983-1984
Frontal Aviation				
Fighter/Ground Attack	2,635	2,650	2,050	2,425
Fighters	1,750	1,700	1,750	2,850
Subtotal, Frontal Aviation b/				
From IISS	4,385	4,350	3,800	5,275
From *Soviet Military Power* c/	--	(4,800)	(6,200)	(6,280)
From JCS d/	--	--	--	(5,478)
Strategic Interceptors	2,600	2,500	2,250	1,250
Total	6,985	6,850	6,050	6,525

SOURCE: International Institute for Strategic Studies (IISS), *The Military Balance, 1980-1981, 1981-1982, 1982-1983,* and *1983-1984.*

a. The increases in fighter and fighter/ground attack aircraft shown in these figures might be a reflection of the Soviet reorganization of its tactical air forces as much as of an increase in aircraft. Previously, a very large number of the Soviet fighter inventory belonged to PVO Strany (Protivovozdushnaia oborna strany--National Air Defense), the Soviet air defense command. In the early 1980s, control of many of these aircraft was given to Soviet military districts. As can be seen here, the strategic interceptor totals between 1980 and 1984 decreased by almost 1,400 aircraft while the fighter and fighter ground attack totals increased by approximately 900 aircraft.

b. Only the figures from the IISS for frontal aviation are included in the totals.

c. Department of Defense, *The Soviet Military Power* (1983 and 1984). DoD includes these figures in its conventional forces discussion, so it is assumed that they do not contain strategic aircraft.

d. The Organization of the Joint Chiefs of Staff, *Military Posture FY 1985.*

TABLE 4. NATO/WARSAW PACT FORCE BALANCES
(By fiscal year, in number of aircraft and ratios)

	1980-1981			1981-1982		
	NATO	Ratio	Warsaw Pact	NATO	Ratio	Warsaw Pact
Fighter/ Ground Attack	2,214	1.32:1	1,675	2,293	1.31:1	1,755
Fighter	0		0	204	1:3.6	665
Subtotal	2,214	1.32:1	1,675	2,497	1.03:1	2,420
Interceptors	588	1:5.19	3,050	572	1:2.61	1,490
Total	2,802	1:1.69	4,725	3,069	1:1.27	3,910

(Continued)

for Strategic Studies; numbers supplied by U.S. military authorities show larger Soviet totals. 5/

The picture is also less favorable to the United States if interceptor aircraft are considered (see Table 3). Including interceptors, Soviet totals do decline from 1980 to 1984, but the actual number is always larger than the one that reflects only fighter/attack aircraft. These interceptor aircraft are intended primarily for defense of the Soviet Union against U.S. nuclear bombers, but they could also be used in a conventional war. Thus, their inclusion in the comparison may be reasonable.

A generally similar picture emerges when the assets of the United States and its NATO allies are compared with those of the Soviet Union and its Warsaw Pact allies (see Table 4). Relative parity exists today between NATO and the Warsaw Pact if only fighter and fighter/ground attack (FGA) aircraft are considered. This parity, however, represents a decrease from

5. See International Institute for Strategic Studies, *The Military Balance* (various years); Department of Defense, *The Soviet Military Power* (1983 and 1984); and Organization of the Joint Chiefs of Staff, *Military Posture FY 1985*.

TABLE 4. (Continued)

	1982-1983			1983-1984		
	NATO	Ratio	Warsaw Pact	NATO	Ratio	Warsaw Pact
Fighter/ Ground Attack	2,355	1.40:1	1,685	2,186	1.30:1	1,685
Fighter	138	1:5.07	700	212	1:3.30	700
Subtotal	2,493	1.05:1	2,385	2,398	1.01:1	2,385
Interceptors	614	1:7.14	4,382	647	1:6.77	4,382
Total	3,107	1:2.18	6,767	3,045	1:2.22	6,767

SOURCE: International Institute for Strategic Studies, (IISS), *The Military Balance, 1980-1981, 1981-1982, 1982-1983,* and *1983-1984.*

1980 when NATO enjoyed a 1.3 to 1 advantage. When interceptors are included, as they probably should be, the Warsaw Pact always has enjoyed an advantage and it has increased in recent years, from 1.7 to 1 in 1980 to more than 2 to 1 in 1984. 6/

These imbalances reflect both NATO budget restrictions and NATO decisions to match quantity with quality. NATO members have felt that paying for comparable force numbers is difficult; hence NATO (and the U.S. Air Force) has invested more of its funds in quality than in quantity.

The Defense Department is, therefore, somewhat more concerned about projections for increases in the capability of the Soviet aircraft (which also supply other Warsaw Pact nations) than it is in the Warsaw Pact's longstanding quantitative advantages. The Soviet Union has been modernizing its force structure for a long time, transforming what was once a force capable largely of national air defense into what the DoD considers

6. If an air war were carried out above Warsaw Pact territory, it seems reasonable to assume that Warsaw Pact interceptors would not be withheld from the battle. It is, however, less clear that Soviet interceptors would be used tactically.

a force capable of long-range attack into NATO territory. In particular, the Air Force describes three new Soviet aircraft--the Mikoyan MIG-31 (Foxhound), Sukhoi SU-27 (Flanker), and the Mikoyan Mig-29 (Fulcrum)--as posing threats to NATO forces. Indeed, the Air Force has indicated that the Flanker and Fulcrum might be the equals of current generation U.S. fighters.

The Air Force not only faces an enemy that has increased in numbers and quantity, but also must counter a widely dispersed foe. The United States has worldwide commitments that would require the use of tactical aircraft if conflict were to break out. The Department of Defense is concerned that Soviet ability to launch simultaneous large-scale offensives in widely separated theaters has increased. In response, the Air Force--in addition to the 60 fighter squadrons committed to deploy to Europe--is required to provide seven tactical air wings to the U.S. Central Command (formerly called the Rapid Deployment Joint Task Force--RDJTF), which is responsible for responding to Soviet aggression in Southwest Asia. While by far the bulk of the tactical air forces available to the U.S. Commander in Chief in the Pacific would be naval, the Air Force also is committed to provide 10 squadrons should war break out in the Pacific region. This could require the ability to sustain combat in several widely dispersed theaters.

While these trends indicate a substantial increase in the air threat confronting NATO, there may be some moderating factors. First, the new Soviet Flanker aircraft has not been fielded, and the Fulcrum has just been introduced to the Soviet forces; so perhaps it is too soon to tell whether Air Force fears about the planes' capabilities will be realized. Until the United States has had time to learn more about the aircraft, reports of capability comparable to current generation U.S. fighters will remain somewhat speculative. Second, if the new Soviet planes do prove to be the equals of F-15s and F-16s, they are likely to be more complex than former Soviet aircraft, and such complexity might complicate Soviet deployment of these aircraft. 7/ Indeed recent press reports indicate that there has been some delay in the fielding of the Flanker and Fulcrum. Third, more capable aircraft are as likely to be more expensive for the USSR as they are for the United States, and if one looks at recent reports of Soviet fighter/attack aircraft, production has decreased over the last several years from 1,350 in 1981 to 950 in 1983. 8/

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7. See, for example, Joshua M. Epstein, *Measuring Military Power -The Soviet Air Threat to Europe* (Princeton: Princeton University Press, 1984).

8. Department of Defense, *Soviet Military Power 1984* (April 1984).

The Air Force sets its goals for tactical forces by assessing the capability of the U.S. and allied forces versus Soviet and Warsaw Pact threats. It is inevitably a highly uncertain process, and all the armed services initially set goals that are much higher than current force levels. The highest goals are associated with minimum risk; these are the forces that the services feel they would need in order to have a high probability of winning a major war. For example, if the minimum risk forces for the tactical air forces involved achieving quantitative parity with the Soviet Union, about 60 wings would be required, or about twice the size of the current force. Indeed, press reports indicate that the Air Force minimum risk planning force might be about 60 wings. 9/ Clearly, it would be difficult for the Air Force to receive the funds necessary to attain this level, and it might be unnecessary as NATO aircraft are, at least currently, more capable in general. Thus by accepting more risk, the services reduce requirements to levels more consistent with fiscal constraints, in conformity with DoD guidance. The plan for 40 wings is presumably consistent with the fiscal constraints that the Air Force has been told to meet.

Requirements for 40 Wings

Expanding to 40 wings would require about 4,000 aircraft by 1991, assuming 100 aircraft per wing. (While the Air Force currently has about 4,000 aircraft, intended F-4 retirements will require additions to support 40 wings.) Each wing has 72 combat or primary authorized aircraft (PAA). But, according to the Air Force, an additional 28 aircraft per wing are needed as backups. Of the 28 additional aircraft, 18 are trainers (TF) that are needed to help pilots make the transition from one type of aircraft to another. The remaining 10 aircraft are a combination of "pipeline" and support aircraft for research and development (back-up aircraft authorizations--BAA). Pipeline aircraft are the additional aircraft needed to keep combat levels constant while aircraft undergo modification and repair. Support aircraft for research and development are those that are used to test new systems--both aircraft systems and weapons.

Some controversy exists over whether all 28 of these additional aircraft are needed. The General Accounting Office (GAO) has argued that it would be possible to reduce pipeline requirements if better maintenance practices were put into place; GAO also contends that higher use of training

9. Charles Doe, "Defense Analyst Calls for U.S. Strategy Shifts," *Navy Times* (October 8, 1984).

aircraft could reduce aircraft requirements. 10/ Moreover, there is some question as to whether the Air Force needs as many training aircraft for reserve wings, which form about a third of the force, as for active wings. Reserve wings are manned by part-time personnel who train mostly on weekends; these wings are generally composed of experienced pilots who might not need as much refresher training as the inexperienced pilots entering active duty. Others have argued that, since the Air Force does not procure aircraft in anticipation of wartime attrition as the Army does tanks, these additional aircraft might be needed for that purpose, if not for the expressed purposes of training and maintenance.

For the purposes of this analysis, however, official Air Force figures were used, and these call for 100 aircraft per wing, including 72 combat and 28 additional aircraft. It should be kept in mind that different assumptions about these back-up aircraft would reduce the requirements.

Requirements Versus Available Aircraft

CBO's projections suggest that, if the Administration's February 1985 procurement plans are carried out, there would be a decrease in inventory levels in the late 1980s and the Air Force would not attain the required inventory of 4,000 aircraft during this time period (see Figure 4). An average shortfall of about 100 aircraft between requirements and inventory would prevail from 1990 through 1992. This shortfall could, however, be met by retiring F-4s an average of only one year later than the planned 20 year service life. Thus it appears that the Administration's current plans for procurement are roughly consistent with its current plans for increasing tactical air wings.

AFFORDABILITY OF AIR FORCE PLANS

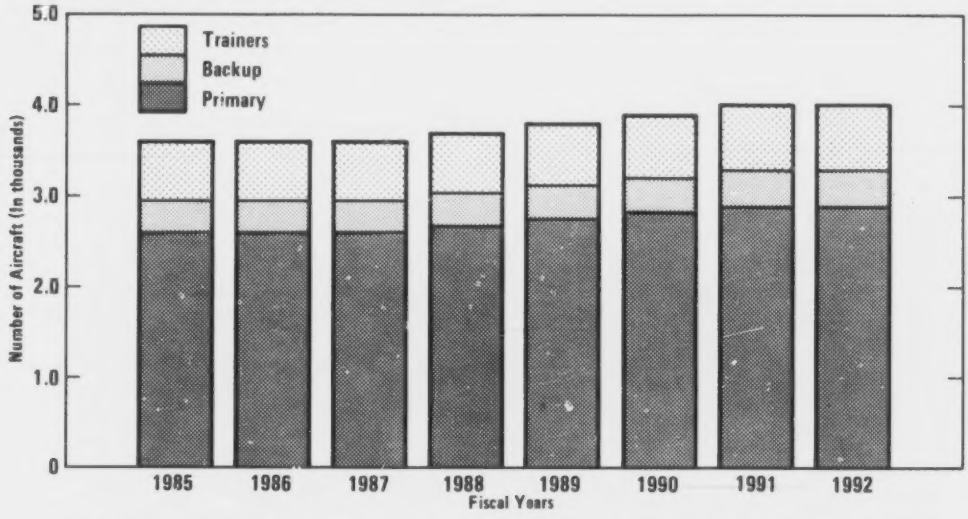
Unfortunately, it is difficult to provide a definitive answer to the question of affordability of Air Force plans for two reasons. First, it is not clear how much money the Congress will appropriate for DoD over the next five years and how much the Congress will allocate to tactical air forces. The Congress makes these detailed decisions about the overall defense budget and its allocation to specific programs only for the current budget year, not for five years. Second, DoD's long-term plans, which are highly detailed, cannot

10. See *DoD Justification of Aircraft for Noncombat Missions*, Hearings before the Subcommittee on Legislation and National Security of the House Committee on Government Operations, 98:1 (June 2, 1983), pp. 3-5.

be used as a guide. Except for the up-coming budget year, the Administration views these plans as internal working documents, and they are not routinely supplied to the Congress. The Congress does receive long-term plans about the numbers of aircraft that will be purchased and other selected information, but it does not receive details about operating costs and other factors required to estimate the total funds that would be needed to support Administration plans for tactical air forces.

Nonetheless, CBO has estimated that the cost of Air Force plans would require that the tactical force budget increase from $17.5 billion in 1986 to $22.5 billion in 1990 (see Table 5). 11/ That represents real increases over the 1985 budget level averaging 2 percent a year. Thus, if the Congress grants increases of 5 percent a year in defense spending--as it indicated it might in the long-term budget resolution passed in 1984--and

Figure 4.
Tactical Air Force Requirements



SOURCE: Congressional Budget Office based on Fiscal Year 1986 Department of Defense Annual Report to Congress.

NOTE: For purposes of analysis, CBO assumed that force growth would be uniform and any slippage would occur in the near term. This might not reflect actual DOD plans.

11. The tactical forces budget is defined as the direct cost of procuring and operating tactical air forces. This estimate excludes the facilities, indirect operating costs, research and development costs, and other indirect costs that would increase the tactical air budget but which cannot be estimated precisely.

allocates at least that percent increase to the tactical forces, these plans should be affordable. Nor should the plans require a larger share of the Air Force budget, unless the Air Force share of the defense budget is cut.

The estimate that growth of about 2 percent would pay for the Administration plans differs from a May 1984 paper prepared by the CBO. 12/ That paper found that the fiscal year 1985 tactical forces budget exceeded 5 percent real growth. Since this analysis, however, two things have occurred that make tactical force costs fall within 5 percent real growth, and indeed even within 3 percent real growth (see Table 5). First, Congressional action increased tactical aircraft procurement funding by 28 percent, from the fiscal year 1984 budget to the 1985 budget, thus increasing funding for the "base" year and hence the money available in later years, assuming annual real growth of 3 percent or 5 percent. Second, the Air Force has submitted a new plan that reduces the funding associated with the tactical aircraft budget. From the common years between the two budgets, 1986 through 1989, the Air Force removed about $3 billion and 180 aircraft from its planned procurement. Reflecting this reduced procurement, the Air Force also slipped reaching its 40-wing goal from 1989 to 1991.

Although according to the estimates in Table 5 the Air Force plan seems affordable with moderate annual real growth, the estimates do make some important assumptions that could understate future cost increases. Operating costs for the force structure during the fiscal years 1985-1990 period were estimated using the Defense Resources Model (DRM), which assumes no real increases in operating costs. Specifically, the model assumes that the real costs to operate a particular type of aircraft will increase only as more of the aircraft are added to the force structure. Thus, for example, the DRM assumes that, in real terms, an F-4 will cost the same to operate in 1990 as it did in 1985.

Historically, though, costs to operate and support the force have gone up over time. Operation and support costs are made up of two components: operation and maintenance (O&M) and military personnel costs. O&M, the component of O&S costs that pays for training and fuel and most spare parts, has increased threefold per aircraft during the period from 1963 through 1983. On average, that suggests growth equal to about 6 percent a year. On the other hand, military personnel costs per aircraft, the other major part of O&S, have grown by an average of only about 1 percent a year over that period. Thus overall real growth in O&S has averaged a little over 3 percent a year. Moreover, this rate of growth has been sustained in recent

12. See Congressional Budget Office, *Tactical Combat Forces of the United States Air Force: Issues and Alternatives* Staff Working Paper (May 1984).

years and so does not seem to be dependent on the sharp shifts toward more complex aircraft that took place in the 1970s.

Nor are unit costs for operating and support the only ones that could grow. The estimates of procurement costs in Table 5 are based on unit prices in the fiscal year 1986 budget submissions and reflect Air Force projections for price decreases. The Air Force projects that procurement unit costs for the F-16 will be 15 percent lower in real terms in 1990 than they are in 1985, and that costs for the F-15 will decrease by about 30 percent during the same period. Historically, however, tactical aircraft prices have grown, reflecting, at least in part, aircraft model changes. For example, over the last five years, unit costs of F-15s and F-16s have grown in real terms by annual rates of 15 percent and 11 percent, respectively.

TABLE 5. COST OF VARIOUS TACTICAL AIR FORCE GROWTH PLANS, FISCAL YEARS 1986-1990 (In billions of dollars of budget authority, under Administration inflation assumptions)

Planned Growth	1986	1987	1988	1989	1990	Total 1986-1990
Administration Plans a/	17.5	18.2	20.1	21.8	22.5	100.1
Amounts Available to Tactical Air Force at						
5 percent real growth	18.1	20.0	21.9	24.0	26.3	110.3
3 percent real growth	17.8	19.2	20.7	22.2	23.9	103.8

SOURCE: Congressional Budget Office estimates from fiscal year 1985 budget submission (3 and 5 percent real growth) and fiscal year 1986 budget (for procurement), plus CBO estimates of operating and support costs.

NOTE: Numbers may not add to total because of rounding.

a. Projected by CBO based on operations and support spending levels programmed in the fiscal year 1985 defense budget.

Should these trends in unit costs of procurement and O&S continue, costs could be higher than those displayed in Table 5. Assume, for example, that O&S costs grow at 3 percent a year and, as the Air Force plans model changes to both aircraft now being procured, that unit procurement costs grow at about 10 percent a year (versus the price reductions now reflected in the plans). Then total costs over the next five years would equal $118.9 billion and would grow at an average annual real rate of about 7 percent rather than the 2 percent shown in Table 5.

POSSIBLE ALTERNATIVES

Even assuming that CBO estimates of 2 percent annual real growth do not prove to be overly optimistic, the Congress might still reduce the defense budget in order to reduce the large federal budget deficits. The previous discussion considers whether Air Force plans could be accommodated under alternative real growth rates in expenditures. These rates, 3 percent and 5 percent, were chosen to be consistent with most recent discussions of overall DoD budgetary increases. These growth rates could fall, however, implying crudely that less might be available for all components of the DoD budget, including the Air Force tactical forces.

Budget shares for tactical aircraft could also fall. The other programs that compete with tactical aircraft for funding might receive higher priority from the Administration and the Congress over the next five years. The two major strategic programs that now compete with tactical aircraft for Air Force funds--MX and B-1--would be largely complete by the late 1980s if they continue on schedule. But they might not meet current schedules. Some possibility exists that MX procurement might be stretched out, and some analysts doubt that the B-1 program will simply stop procurement in 1986 after 100 planes have been bought. The MX and B-1 programs could receive higher priority than tactical air forces and could continue to compete for Air Force funds through the 1980s if the strategic programs are delayed or extended. Additionally, the Air Force has several developmental projects that could become competitors for production funds in the late 1980s. In the strategic arena, these include the new, small missile program; the Stealth bomber; and the Strategic Defense Initiative to develop defenses against ballistic missiles. Also, the C-17 transport aircraft, a high priority of the Air Force as well as the Army, should begin procurement in 1988, the same time that tactical fighter procurement is expected to reach its high point of 276 per year.

Even within the tactical aircraft area, there are some inherent competitors. The Air Force is planning to develop the F model derivative of the

F-16; it is also planning increases in Advanced Tactical Fighter (ATF) development (see Chapter IV). CBO cannot easily estimate development funds for these programs because the Congress receives detailed plans for research, development, test and evaluation (RDT&E) accounts for only two years beyond the current budget year. But the Senate Appropriations Committee has expressed concerns about the ambition of these plans, suggesting that the Air Force might wish to consider the impact of F-16F development on ATF funds.

Finally, an intrinsic aspect of tactical aircraft procurement makes it an attractive target for defense budget cutters. Aircraft are usually bought in substantial numbers. Thus it is possible to cut aircraft procurement by slowing but not cancelling programs, hence avoiding the difficult step of terminating a project. And, because of the expense of tactical aircraft, such slowdowns yield large savings in the near term, albeit at the expense of increases in unit costs, which are, at least in part, related to the size of the production rate.

CHAPTER III

ALTERNATIVE APPROACHES TO TACTICAL AIR FORCE EXPANSION AND MODERNIZATION

With Congressional interest in reducing the federal deficit, spending on the tactical air forces might be lowered. This chapter considers several alternatives to current Administration's plans that would reduce the forces' costs, including two that would cancel procurement programs.

Acting now to change long-term plans, even cancelling programs in anticipation of future funding problems, would be consistent with an Air Force study released in 1983. 1/ That study concluded that the Air Force now takes longer to complete its procurement plans than it did in preceding decades and that, as a result, procurement costs more in real terms. A major contributing factor, according to the study, is that today's plans assume higher increases in funding than the Air Force is likely to obtain. When funding levels are lower than expected, the Air Force spreads procurement of systems over more years, thereby causing unit costs to rise. The study points out that, while delaying procurement programs remains an option, the Air Force also could consider cancellation of programs.

POSSIBLE CHANGES IN KEY GOALS

The Administration's plans discussed in Chapter II embody three key goals:

- A quantitative goal to build up the force structure to 40 wings by 1991;
- A qualitative goal to improve force capability with F-15s and modifications to both F-15s and F-16s; and
- A modernization goal to be achieved by retiring old F-4 aircraft, replacing them with F-15s and F-16s.

Under tighter budgets, the Administration and the Congress might be forced to choose among these three goals. This chapter considers five alter-

1. *Affordable Acquisition Approach* (prepared for the Air Force Systems Command by a study group headed by Lt. Gen. James Stewart, USAF (Ret.), January 1983).

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native procurement programs that could aid the Congress in making policy decisions about the quantity of the aircraft inventory versus its quality and age. Option I discusses the Administration's program--which proposes increased quantity and increased modernization--its costs, and its effects on potential capability. 2/ Options II and III emphasize force expansion over force modernization, although both options continue to modernize the force. Option II continues F-15 procurement, albeit at a slower rate, thus reducing the numbers of the highest quality aircraft in the inventory. The option attains the Administration's quantitative goal of 40 wings by 1991.

Option III substantially slows qualitative improvements by cancelling F-15 purchases. In order to meet the Administration's objectives for force growth, the option modifies and retains F-4s in the force structure for considerably longer than the Administration's 20-year retirement goal. Options IV and V deemphasize force expansion while continuing the modernization program. Option IV suspends the objective of force growth while retaining goals for qualitative improvement by continuing to procure F-15s. Finally, Option V slows meeting, or suspends each of the three goals, producing the least costly but also the least capable of all the options considered. Table 6 summarizes the options and their effects on the three key goals.

OPTION I -- THE ADMINISTRATION'S PROGRAM

The Administration's program (Option I) seeks to meet all three of the Air Force's key goals. It plans to expand the tactical forces to 40 wings by 1991. At the same time it would modernize the forces aggressively with new aircraft (F-15s and F-16s) and retire older F-4 aircraft at around 20 years of age. Thus this option is consistent with the assumptions that the United States must improve its capability relative to the Warsaw Pact and that Soviet aircraft will improve in quality. The Administration's plan also takes into account the fact that the Warsaw Pact has more tactical aircraft than NATO and the assumption that the Air Force's requirements to respond simultaneously to conflicts in more than one theater are not likely to abate through the end of the decade. Needless to say, meeting a threat that is improving in quality and potentially multitheater in nature is expensive, and Option I is the most expensive of those considered in this study.

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2. In order to assess the potential capability of the alternative forces, CBO used a model discussed later in this chapter and in Appendix B. Because the model only assesses aircraft performance aspects and does not account for other factors, like air crew ability, it only provides a measure of potential force capability inherent to the aircraft that comprise each force.

TABLE 6. EFFECT OF OPTIONS ON AIR FORCE GOALS

Option		Meets Quantitative Goal of 40 Wings by 1991	Level of Qualitative Improvement	Retire F-4s
I	Administration	Yes	Substantial	Near 20 years' service
II	Expand Forces, Slow Qualitative Increase	Yes	Modestly less than Administration	Near 20 years' service
IIIA	Expand Forces, Slow Modernization, Substantial F-4 Improvement	Yes	Less than Administration	Improve and keep until 30
IIIB	Expand Forces, Slow Modernization, Modest F-4 Improvement	Yes	Less than Administration	Improve modestly and keep until 30
IV	No Force Growth, Maintain Quality Increases	No	Substantial	Near 20 years' service
V	No Force Growth, Slow Quality Increases	No	Less than Administration	Near 20 years' service

SOURCE: Congressional Budget Office.

Detailed Description and Costs

Over fiscal years 1986 through 1990, the Administration's program would procure a total of 1,284 aircraft. Of these, 40 planes would be F-15C/D models and 236 would be follow-on dual role aircraft, the F-15E. The remainder of the procured aircraft would be F-16C/Ds, although it is possible that a few of the F-16s procured in 1989 and 1990 could be follow-on F models.

Procurement costs for this option would total about $5.9 billion in 1986 and $34.5 billion over the five-year period (see Table 7). This procurement schedule would enable the Air Force to attain its 40-wing goal by 1991, as planned, if it retires F-4s a year later than its desired age of 20 years. Table 7 also shows the operating and support (O&S) costs associated with the increasing force structure. Under the conservative modeling assumptions discussed in Chapter II, whereby O&S costs increase only as forces increase rather than reflecting the historical pattern of about 3 percent real increases per year per aircraft, operating and support costs would increase from $11.6 billion in 1986 to $14.8 billion by 1990 and would total $65.6 billion over the five-year period. Thus the total costs of Option I would amount to $17.5 billion in 1986 and $100.1 billion over the next five years.

Effects on Potential Capability

Model Results. Not surprisingly, the most expensive option in the study also results in the most improvement in the capability of the tactical forces. Using a model described below, CBO estimates that this option would improve the overall capability of tactical forces by 32 percent between 1985 and 1992 (see Table 8). (Fiscal year 1992 is selected because by then all the aircraft purchased over the next five years will be in the inventory.)

Model. This estimate of force improvements is based on a model developed by The Analytic Sciences Corporation (TASC) at the request of the Office of the Secretary of Defense. The Technique for Assessing Comparative Force Modernization (TASCFORM) Model develops a group of weighted performance figures for the aircraft included in the various options by comparing system performance characteristics--such as the range of the aircraft, its maximum payload, proxies for its maneuverbility, and so forth--with those of a selected baseline aircraft. The model weights these characteristics for the missions--fighter, interceptor, close air support, and interdiction--that the aircraft might be expected to perform. These performance figures are then multiplied by the inventory levels for the

TABLE 7. COST OF THE ADMINISTRATION PROGRAM AND SAVINGS OF ALTERNATIVES (By fiscal year, in billions of then year dollars in budget authority) a/

Option		1986	1987	1988	1989	1990	Total
I	Administration						
	Procurement	5.9	5.9	7.1	7.9	7.7	34.5
	Operating & Support	11.6	12.3	13.0	13.9	14.8	65.6
	Total	17.5	18.2	20.1	21.8	22.5	100.1
	Savings from Administration Program						
II	Expand Forces, Slow Qualitative Increase						
	Procurement	0.5	0.4	0.8	0.8	0.8	3.4
	Operating & Support	0.0	0.0	0.0	0.0	0.1	0.1
	Total	0.5	0.4	0.8	0.8	0.9	3.5
IIIA	Expand Forces, Slow Modernization, Improve F-4						
	Procurement	2.1	1.8	2.1	0.3	-0.2 b/	6.1
	Operating & Support	0.0	0.0	0.0	0.0	0.2	0.2
	Total	2.1	1.8	2.1	0.3	0.0	6.3
IIIB	Expand Forces, Slow Modernization, Improve F-4						
	Procurement	2.1	1.8	2.3	2.4	2.2	10.8
	Operating & Support	0.0	0.0	0.0	0.0	0.2	0.2
	Total	2.1	1.8	2.3	2.4	2.4	11.0
IV	No Force Growth, Maintain Qualitative Increases						
	Procurement	0.5	0.5	1.5	1.6	1.5	5.6
	Operating & Support	0.0	0.0	0.1	0.4	0.7	1.2
	Total	0.5	0.5	1.6	2.0	2.2	6.8
V	No Force Growth, Slow Modernization						
	Procurement	2.1	1.8	3.0	3.6	3.5	14.0
	Operating & Support	0.0	0.0	0.1	0.4	0.8	1.4
	Total	2.1	1.8	3.1	4.0	4.3	15.4

SOURCE: Congressional Budget Office projections based on fiscal year 1985 budget for operating and support; and on fiscal year 1986 budget submission for procurement costs.

NOTE: Numbers may not add to totals because of rounding.

a. Administration inflation assumptions.

b. Because the numbers in this section are reductions to the cost of the Administration's plan, the minus sign denotes an addition to the costs.

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aircraft. Obsolescence is also factored in as a function of the time since the aircraft entered the force. (See the following box and Appendix B for additional details about the model.)

Limits of the Model. Key factors in the model, especially the weights that determine the importance of system performance characteristics, are determined by judgments of tactical aircraft experts. Such judgments mean that results are subjective, but unfortunately there are no objective means to perform an overall analysis. In part because of this subjectivity, the TASCFORM model is most useful for assessing relative Air Force modern-

TABLE 8. SUMMARY OF EFFECTS OF OPTIONS ON POTENTIAL CAPABILITY

Option		Number Wings 1992	Aircraft Procured 1986-1990
I	Administration	40	1,284
II	Expand Forces, Slow Modernization	40	1,188
IIIA	Expand Forces, Slow Modernization, Improve F-4	40	1,008 (336 F-4s Modified)
IIIB	Expand Forces, Slow Modernization, Improve F-4		
IV	No Force Growth, Maintain Modernization	36	1,080
V	No Force Growth, Slow Modernization	36	900

(Continued)

ization trends and the technical performance potential for alternative forces. This is how it is used in this paper. The model does not quantify actual combat capability; it cannot therefore be used to predict the outcome of a war. The Air Force attempts to capture some of the other factors likely to affect combat outcomes by using complex computer simulations that incorporate aircraft and weapon systems performances along with many other factors, including the readiness of aircraft and their crews, the ability to sustain the aircraft with spare parts and weapons in a protracted war, location of aircraft bases, whether the bases provide shelters against enemy attack, and so forth. Alternative strategies are also

TABLE 8. (Continued)

Option	Inventory as of 1992				
	Increase in Potential Capability Over 1985	Average Age	Percent F-15	Percent F-16	Percent F-15 & F-16
I	32	9.7	22	44	66
II	28	10.1	20	44	64
IIIA	28	11.1	15	44	59
IIIB	28	11.1	15	44	59
IV	21	9.7	21	45	66
V	16	10.5	17	46	63

SOURCE: Congressional Budget Office estimates from Department of the Air Force data.

STEPS IN DEVELOPING TASCFORM ESTIMATES OF CAPABILITY

1. Estimate basic airframe performance for each mission the plane performs, based on:

   - o Payload (that is, maximum pounds of weapons that can be carried)
   - o Aircraft range and standoff weapon range
   - o Maneuverability
   - o Highest speed

2. Adjust airframe performance for the systems that the plane carries which affect:

   - o Target acquisition and guidance/fire control
   - o Susceptibility to countermeasures
   - o Weapon enhancements
   - o Navigation
   - o Survivability

3. Adjust for the number of sorties that the plane can perform.

4. Produce a composite figure for each mission. Mission scores are weighted by the fraction of time each aircraft spends in each mission and a total score is produced.

5. Depreciate composite score. Successive small yearly reductions of this score reflecting aging of aircraft are made.

6. Reflect size and composition of the aircraft inventory. Multiply scores by numbers of each type of aircraft in the inventory and sum to produce tactical inventory performance scores.

SOURCE: Congressional Budget Office from The Analytic Sciences Corporation, *The TASCFORM Methodology: A Technique for Assessing Comparative Force Modernization* (January 1984).

considered using these simulations. CBO has not attempted such analysis in this paper.

Other Ways of Assessing the Alternatives. The TASCFORM model is not the only way to assess the Administration's plan. Another method is to calculate the percentage of relatively more capable aircraft in the force structure. By 1992, under the Administration's program, 66 percent of the inventory would consist of F-15 or F-16 aircraft, the two newest and most capable aircraft (see Table 8). This is higher than all but one option in this study and equal to that one. Moreover, under the Administration's plan 22 percent of the force would consist of F-15 aircraft, the highest percentage in any of the options. Although the F-16 is a capable aircraft, the Air Force believes the F-15 is the most capable in the tactical forces. According to the Air Force, the follow-on F-15E also will be superior to its competitor, the F-16E, in the air-to-surface role. Hence, the percent of F-15s could be viewed as the most capable part of the inventory, with the percent of F-16s indicating the newer but somewhat less capable portion of the mix.

Yet another approach is to consider the average age of the forces, a proxy for newness and hence for effectiveness. The Air Force has set ten years as a goal for the average age of the force, reflecting its desire for retirement of aircraft at 20 years of age. By 1992 the force under this option will be under that limit, at an average age of 9.7 years. Both of these alternative ways of assessing the Administration's plan corroborate CBO's assessment using TASCFORM. By all three measures, the Administration's program substantially increases capability.

Regardless of the surrogate for capability used, then, the Administration's program clearly results in an expanding number of tactical forces and a force substantially more capable than today's. As such, this option, among all those in this study, offers the least risk in any future conflict. If, however, the Congress decides that the Administration's option is too expensive, then it would need to choose how to improve the tactical forces with a lesser amount. The following five options suggest such alternatives.

OPTION II -- EXPAND NUMBERS BUT SLOW MODERNIZATION

This approach would continue to expand the size of the tactical forces, building toward the goal of 40 wings in 1991, but slow qualitative enhancements by purchasing fewer F-15 aircraft, the more expensive aircraft of the two now being bought. To add wings while purchasing fewer F-15s, some old F-4s would be kept longer. This approach is not without precedent. For the past four years, the Congress has reduced F-15 procurements when it sought

to cut defense costs. The Air Force itself has also cut back on F-15 purchases when required to reduce its budget and appears to be planning to keep some F-4 aircraft beyond 20 years of service.

This option is consistent with an emphasis on total numbers of aircraft rather than the numbers of the most highly capable aircraft. As earlier indicated, some analysts believe that total numbers of aircraft could be very important in the complexity of a modern battlefield. They argue, for example, that support for highly capable aircraft could be difficult under harsh battlefield conditions, and that larger numbers would be needed to replace those aircraft rendered irreparable by severed supply lines. This option would also be consistent with an emphasis on the ability to fight simultaneously in several areas of the world.

Detailed Description and Costs

In recent years, the Congress has authorized procurement of between 36 and 42 F-15 aircraft annually. Option II continues this course by slowing F-15 procurement to 36 per year (see Table 8). Thus this option would buy 96 fewer F-15s over the next five years than would the Administration. In order to continue expanding the fleet despite this reduced procurement, Option II would keep F-4s in the inventory until they have reached 22 years of service, rather than retiring them after about 21 years of service as does the Administration's option.

Because of this slower modernization schedule, Option II would cost $17.0 billion in 1986 and a total of $96.6 billion from 1986 through 1990. This represents savings of $0.5 billion in 1986 and $3.5 billion in the 1986-1990 period relative to the Administration's program (see Table 7). Almost all the savings would come from reductions in procurement of the F-15. Since this option would build the same number of wings as the Administration's program, the operating and support costs are about the same. The options do differ in the mix of types of aircraft, but that is barely significant at this inventory size.

Effects on Capability

Between 1984 and 1992, Option II would increase the potential capability of the tactical forces by 28 percent, based on the TASCFORM model discussed above (see Table 8). This compares with a 32 percent increase under the Administration's option. The reduction in growth in potential capability, although significant, is not unlike others that the Administration has been

willing to accept in recent years. Between the fiscal year 1985 and the fiscal year 1986 budgets, the Administration and the Congress decided to buy fewer tactical aircraft to reduce costs. The capability decrease resulting from this change is comparable to that which would result from choosing Option II over the Administration's 1986 program.

The other, simpler measurements (discussed above) follow the same pattern as the TASCFORM model results. The percentage of the most capable aircraft, the F-15, would be reduced below the Administration's level (20 percent under this option versus 22 percent under the Administration's) because of the reduction in the rate of procurement. Average age under this option would also be higher than under the Administration's approach (10.1 years by 1992 versus 9.7) because older F-4 aircraft would be maintained longer. Overall, though, this option would reduce costs over the next five years by $3.5 billion while still providing a substantial increase in total capability.

OPTION III -- EXPAND NUMBERS, SLOW MODERNIZATION SUBSTANTIALLY, IMPROVE F-4

Option III would also expand the size of the tactical forces, building toward the goal of 40 wings by 1991. To hold down costs, this option would slow modernization more substantially than Option II by terminating further procurement of the F-15 aircraft. To reach the goal of 40 wings, the option would keep some F-4 aircraft for many years beyond their planned 20-year retirement point. But these F-4 aircraft would be modernized to provide somewhat greater capability, using either a plan proposed by the Boeing Company and other contractors or one proposed by the Air National Guard.

Like Option II, this one emphasizes total numbers of aircraft rather than numbers of the most highly capable aircraft. This emphasis is consistent with some analysts' views of the way to prevail in a modern conflict and with a desire to have large forces that can engage in several simultaneous conflicts. This option would go further than Option II, however, by actually halting further procurement of the F-15 and retaining F-4s, albeit improved F-4s, much longer. 3/ No firm evidence exists that delaying F-4 retirements will increase operating costs, though the Air Force believes it will. The delay in retiring F-4s would, of course, mean a less modern force--although improving the F-4 should offset some of the lost capability.

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3. The option buys the same number of F-16s as would the Administration's program but 120 more of them would be F models. The marginal costs of these aircraft were included, and their capability scores are included in TASCFORM totals.

Detailed Description and Costs

By terminating further procurement of the F-15 aircraft, this option would reduce procurement of that aircraft over the next five years by 276, relative to the Administration's planned level. Terminating the F-15 is not a new idea. The Carter Administration planned no further purchases after fiscal year 1983, and the original total program called for only 729 aircraft. The incoming Reagan Administration decided in 1981 to continue purchases, however, and the Air Force had received funds for 834 F-15s through fiscal year 1985.

Expanding the number of wings without further procurement of F-15 aircraft would require that some 400 older F-4 aircraft be retained in the inventory well beyond their planned 20-year retirement point. The U.S. tactical inventory currently contains about 1,200 F-4 aircraft, and almost all of these aircraft are over 10 years old. Assuming a 20-year retirement of these aircraft, they would have to be replaced entirely by 1997 and, because of their age distribution, replaced in large quantities in the late 1980s (see Figure 5). As earlier indicated, the engineering service lives of F-4 aircraft are longer than 20 years. F-4C/Ds, for example, have service lives well in excess of 30 years, and the F-4E has a service life of about 31 years. 4/ Thus the F-4 could be kept in the inventory longer without undue danger of structural failure. The issue is whether the old F-4s could be modified to be capable against the anticipated enemy threats.

While many approaches to F-4 service life extension are possible, this option considers two alternatives that have been widely discussed. One approach, which the Boeing Company and the Pratt and Whitney Group of United Technologies Corporation have presented to DoD, would involve re-engining the F-4 at a cost of about $12 million per aircraft (Option IIIA). This approach would replace the current F-4 engine with the PW-1120, a turbojet derivative of the F-100 engine now used in the F-15s and F-16s. In addition, this alternative would enhance the F-4's avionics and provide "conformal" fuel tanks (that is, tanks streamlined to reduce drag) on the exterior of the aircraft. The new engine would provide more thrust for the F-4s and hence greater capability in combat against newer Soviet fighters; the conformal fuel tanks would extend its range.

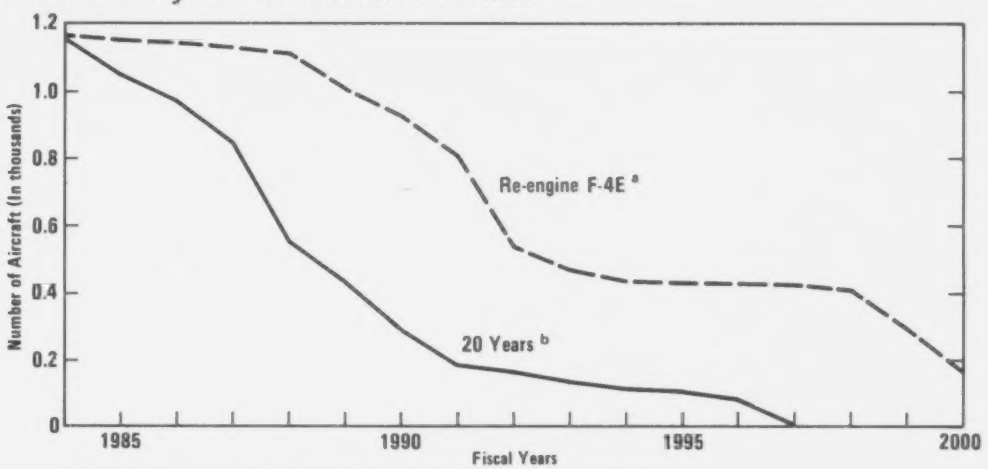
Improving the F-4 also has attracted the attention of foreign governments that want to economize on defense costs. The Israelis plan to develop

4. These service life estimates are expressed in hours. How many years of life an aircraft has depends upon how many hours it flies per year. These estimates assume that recent flying hour profiles do not change.

an F-4 powered by the PW-1120. They might also procure more advanced avionics for their fleet of 131 F-4s. Also, the German Air Force, which has more than 160 F-4s (F models), is apparently considering purchasing conformal fuel tanks.

The U.S. Air Force opposes re-engining their F-4s, however, arguing that they would begin to reach the desired 20-year retirement age before the program could be developed and implemented. This is true. Even assuming the procurement schedule proposed by Boeing, which the Air Force believes is optimistic, the aircraft would be reaching 20 years of age by the time re-engining could occur. The actual structural service life of the aircraft is much longer, however, and, if capability were sufficiently enhanced by re-engining, the proposal might be worth considering. Dr. Richard DeLauer, former Under Secretary of Defense for Research and Engineering, has argued that the proposal would improve the F-4 enough to extend its useful service life for 10 more years and directed the Air Force to release a request for proposal (RFP) for re-engining. 5/ This RFP was released in 1984; it concerns F-4s owned by foreign countries but could presumably be applied to U.S. inventories. Re-engining the F-4, and so extending its life to 30 years, would substantially reduce the numbers of new aircraft needed to

Figure 5.
F-4 Inventory: Two Retirement Profiles



SOURCE: Congressional Budget Office estimates based on Air Force data.

a The re-engining option assumes F-4 retirement as follows: F-4C/Ds at 24 years, F-4Gs at 22 years, and F-4Es at 30 years.

b The Air Force has not yet decided when, or with what, to replace F-4G Wild Weasel aircraft, hence retirement at 20 years (or 22 years for that matter) might be lower than current service plans for F-4G retirement.

5. "Politics Seen Blocking F-4 Upgrading," *Washington Times*, March 14, 1984.

meet Air Force requirements over the next few years. (See Figure 5 which shows the effects of re-engining all the F-4Es while holding the two other kinds of F-4s, C/D and G models, in the force somewhat longer without modification.)

The second F-4 modernization proposal has been put forward by the Air National Guard, which argues that even a less comprehensive F-4 modernization package would extend the lives of their F-4s and at a modest cost (Option IIIB). Improvements that the Guard considers desirable are a new, longer-range radar; integration of the new, advanced, medium-range, air-to-air missile (AMRAAM) when, and if, it becomes available; and the addition of conformal fuel tanks. Because the major cost of the Boeing proposal is the new engines, this different option could cost only about $3 million per aircraft compared with $12 million per aircraft under the Boeing proposal. The Guard has indicated that the F-4 service life for this option would also be 30 years (see Figure 5).

Despite the cost of improving the 336 F-4s under this option, it would still save money relative to the Administration's approach. Over the next five years, savings would range from $6.3 billion to $11.0 billion (see Table 7). Almost all of the savings under this option would come from procurement. Since the number of wings would be expanded under this approach, operating and support costs would be similar to those under the Administration's plan.

Both variants of this option also save more than Option II, which acquires some F-15s but does not improve the F-4s. The high cost of buying any F-15s more than offsets the cost of improving the F-4s. 6/

Effects on Potential Capability

Between 1984 and 1992, the TASCFORM model results suggest an overall increase in tactical force capability of about 28 percent for Options IIIA and B. (The options actually differ by about half a percentage point but because of rounding have the same modernization score.) Interestingly, the improvement is about the same as under Option II, which costs more, but is less than the 32 percent improvement under the Administration's proposal,

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6. The timing of this option could alter the long-run cost savings but not by enough to change the conclusions noted above. It would require some time to develop the F-4 improvement program. Thus, while this option calls for improving 400 F-4s, total costs included over the next five years account for only 336 improvements under Options IIIA and IIIB. Nonetheless, even if costs to improve all 400 could be paid over the next five years, the conclusions above would be unchanged.

which costs substantially more. The improvement under both variants of this option occurs even though CBO has reduced by 10 percent the scores in the TASCFORM model related to performance of the improved F-4. The unreduced data in the model reflect contractor estimates for improved F-4s--which tend to be optimistic--while data in the model for other aircraft reflect actual performance. (CBO also reduced the performance numbers for the F-16F by 10 percent since current production plans are for the late 1980s, though F-15E values were retained.)

The simpler measurements for the options seem to be at odds with the TASCFORM results. By 1992 the average age of the force under this option is 11.1 years, compared with only 10.1 years under Option II (which purchases some F-15s and so retains fewer F-4s) and 9.7 years under the Administration's approach. Thus this option seems less favorable than Option II, contrary to the TASCFORM results. There is, however, an explanation for this discrepancy. These average ages do not "credit" the old F-4s in this option with any improvements from the re-engining, weights that are included in the TASCFORM model.

Additionally, because F-15 procurement is halted, the percentage of the most capable F-15 aircraft under this option is only 15 percent compared with 20 percent under Option II, which procures some F-15s, and 22 percent under the Administration's approach, which purchases many F-15s. While these percentages are valid indicators of the F-15 mix, they again do not reflect the added capability of the re-engined F-4s under this option.

Although these simpler indicators might not do full justice to this option, there is also a disadvantage to the option that neither they nor TASCFORM capture. This approach would postpone the problem of eventually having to replace some older F-4s for as long as ten years. But purchasing new aircraft now would put off that eventuality for 20 years or more.

OPTION IV -- NO FORCE EXPANSION, MAINTAIN MODERNIZATION

Both Options II and III would seek to expand the number of wings to 40 by 1991 while reducing procurement to save money. This means retaining old F-4s in the fleet longer. Option IV would abandon the goal of increasing the number of wings, leaving them at the current level of 36. This would allow some reductions in the numbers of aircraft that are procured in the next five years, but, because the total force would be smaller, the percentage of modernized aircraft could be kept at levels similar to those under the Administration's proposal.

Such an approach is consistent with an emphasis on maintaining a modern fleet with a large percentage of aircraft that are individually highly capable against the best Soviet aircraft. Because this fleet would be smaller in size than under the Administration's approach or those of the previous two options, however, it presumably would not have as much flexibility to engage in multiple, simultaneous conflicts.

Detailed Description and Costs

Option IV would reduce procurement of the F-15 aircraft to 36 a year and would hold procurement of F-16 aircraft to 180 a year, the level of the fiscal year 1986 budget request, rather than increasing F-16 procurement to 216 a year as the Administration plans. Over the next five years, this would mean purchase of 96 fewer F-15s and 108 fewer F-16s than the Administration plans to buy. F-4 aircraft would be retired at about 20 years of service, as under the Administration's program.

The result of these actions would be an inventory sufficient to maintain about 36 wings, roughly the current number. F-15 aircraft would make up about 21 percent of these 36 wings and F-16 aircraft about 45 percent. These numbers are very similar to those under the Administration's approach, which means that, on a percentage basis, this option would maintain the modernization program.

This alternative would also reduce costs relative to the Administration's plan. Savings would amount to $0.5 billion in 1986 and would total $6.8 billion from 1986 through 1990. Over the five years, about $5.6 billion of the savings would come from procuring fewer F-15 and F-16 aircraft, while about $1.2 billion would result from cancelling plans to expand the number of wings, which also would reduce operating and support costs.

Effects on Potential Capability

Between 1984 and 1992, this option would increase overall capability by about 21 percent according to the TASCFORM model. This is substantially less than the 32 percent increase under the Administration's option and also less than increases under either of the other approaches that expand the number of wings. This would occur because the inventory would contain about 400 fewer aircraft than the inventories under earlier options, and the TASCFORM model rewards the larger inventories in the other options.

While the overall increase in potential capability would be less because of smaller numbers, the resulting fleet would be about as young and modern as the inventory under the Administration's approach. The average age of the inventory would be 9.7 years, the same as under the Administration's approach. And, as was noted above, the percentages of F-15 and F-16 aircraft in the inventory would be quite similar to percentages under the Administration's plan.

This option, then, poses a clear choice. If funding must be reduced, it could be done as this option suggests: sacrifice growth in the force in favor of a young, modern inventory. If growth of the force was maintained at reduced levels of funding, it would come at the expense of modernization and qualitative increases.

It seems clear from recent action that the Air Force has chosen the approach illustrated by this option. In every budget since this Administration's first comprehensive plan in January 1982, the time for achieving increased numbers of wings has been delayed (see Figure 6). In the plan submitted in January 1982, the Administration announced that it planned to reach 40 tactical air wings by 1986, with a further increase to 44 wings in later years. By the time the DoD February 1983 plan was submitted, the goal of 40 wings had slipped to 1987; 44 wings were no longer discussed in the annual report, although they were mentioned in hearing testimony. 7/ In the February 1984 plan, the 40-wing goal was set for 1989 and the 44-wing goal had been dropped, at least through the early 1990s. The most recent budget postpones the 40-wing goal until 1991. Thus, confronted with a choice between qualitative improvements or quantitative inreases, the Air Force has consistently preferred quality.

OPTION V -- NO FORCE EXPANSION, SLOW MODERNIZATION

Although Option IV seems to illustrate the Air Force's preferred approach, the Congress could be faced with a need to make substantial reductions in the budget for tactical forces in order to slow the growth in defense spending and reduce the federal deficit. This could require abandoning plans to expand the tactical forces and slowing modernization at the same time. Option V illustrates this approach.

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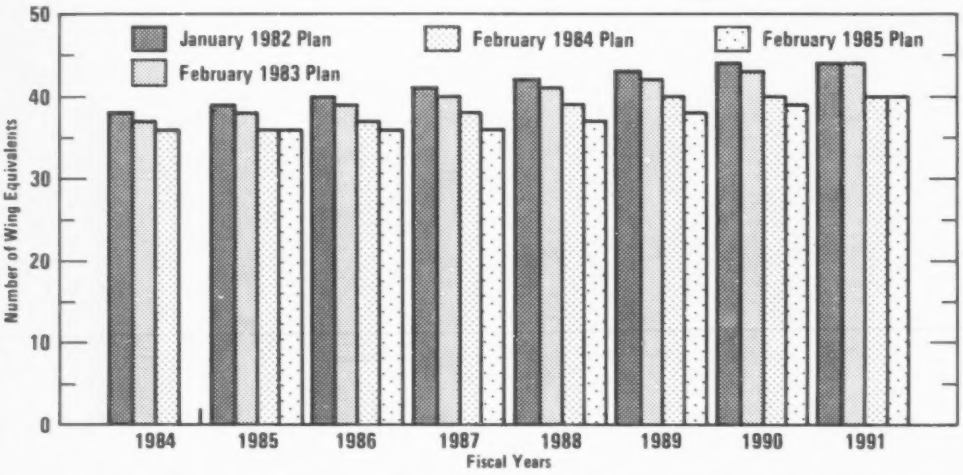
7. *Department of Defense Authorization for Appropriation for Fiscal Year 1984*, Hearings before the Defense Subcommittee of the Senate Appropriations Committee, 98:2 (1983), pt. 5, p. 562.

Option V is consistent with a willingness to take some extra risk in the event of a future war in order to achieve savings now. Without growth, this option would produce a force less capable of dealing with two large conflicts in geographically separated theaters like Europe and the Persian Gulf, or even with one large conflict in Europe. Slowing the modernization program would also mean that fewer U.S. aircraft would be highly capable against the best Soviet aircraft. Savings, however, would be substantial. A major decision facing the Congress is whether the savings from these changes would justify the increase in risk in the event of war.

Detailed Description and Cost

Option V cancels further procurement of the F-15 aircraft and limits procurement of the F-16 aircraft to 180 a year, rather than increasing purchases to 216 a year as the Administration plans. 8/ Thus this option would

Figure 6.
Tactical Force Structure, Based on Fiscal Years 1982-1985 DOD Plans



SOURCE: Congressional Budget Office based on Department of Defense Annual Reports to Congress, Fiscal Years 1983-1986.

NOTE: As the Annual Report only provides long-term goals for force increases and does not provide exact dates as to when the increases will occur, CBO has assumed that increases occur by one wing per year. If the planned increases amount to fewer than one wing per year, CBO has assumed that the force growth will occur in the later years, rather than the earlier ones. CBO assumptions may not reflect exact Administration's plans for interim increases.

8. As with Option III, this alternative pays for and accords performance scores to 120 F-16F models out of F-16 totals.

buy 276 fewer F-15 aircraft and 108 fewer F-16 aircraft than the Administration's program.

The reductions in procurement, combined with no force expansion, would result in substantial savings. Compared with the Administration's plan, savings in 1986 would equal $2.1 billion and total $15.4 billion over the next five years. These savings are by far the largest under any of the options in this study. Most of the savings would come from the reduction in procurement, but the cancellation of planned increases in numbers of wings also would hold down operating and support costs.

Effects on Potential Capability

Along with large savings would come much smaller increases in potential capability. This option would, however, result in some increase in capability--16 percent between 1985 and 1992, according to the TASCFORM model. This would be substantially less, however, than the 32 percent increase under the Administration's program and also well below the increases under any of the other options.

Other, simpler measurements confirm that this option offers less of an increase in capability. The average age of the forces under this option would be about 10.5 years, above the average of 9.7 years under the Administration's approach and slightly above the goal of 10 years set by the Air Force. The percentage of F-15 aircraft in this option would be only 17 percent, considerably smaller than the 22 percent under the Administration's approach.

Clearly, this option would provide a much smaller increase in capability than the Administration's approach or other alternatives in this study. Nonetheless, the option would produce a modest increase in overall capability over today's tactical air forces at substantially less cost than the Administration's proposed approach.

CONCLUSION

As would be expected, the Administration's program for modernizing and expanding Air Force tactical forces is the most expensive of those considered in this study and also offers the most capable forces by a variety of measurements. Thus it should result in the least risk in any future war. If the Congress should feel that less money must be spent, however, it would

need to consider how to improve capability with lower funding and with the least adverse effects.

One approach would be to abandon, or at least scale back, plans to increase the number of wings while continuing to modernize the tactical air forces. Option IV illustrates this approach. This appears to be the Air Force's preferred approach, since it has delayed its goals for expanding the numbers of wings in each of the last three budgets in favor of modernization.

This study suggests, however, that another approach might be at least as good, or better. By continuing to increase the number of wings, but slowing the modernization program, substantial savings could be achieved while minimizing the slowdown in growth of capability. Option IIIB, for example, would build towards the goal of 40 wings but slow the modernization by terminating F-15 procurement and modernizing some F-4 aircraft. Savings under this option would be equal to those under Option IV--which illustrates the Air Force's preference for qualitative improvement--while the reduction in capability is less. The Congress might wish to consider such an approach as it looks for ways to hold down the costs of the tactical air forces.

Of course, if very large savings must be found in the tactical forces budget, then the Congress would probably have to halt growth in numbers of wings and slow modernization. Option V illustrates this approach.

CHAPTER IV

LONGER-TERM CONSEQUENCES OF CURRENT DECISIONS--THE ATF

The preceding chapter focused on near-term options, which involve altering planned procurement or enhancements of aircraft developed many years ago. Development of the F-15, for example, began in 1960. Air Force desires for capability improvements during its design contributed to the substantial cost of that fighter, which, in turn, exacerbates the difficult trade-offs between quantity and quality in today's budget debate.

The Air Force is now beginning development of the advanced tactical fighter (ATF), which is to be fielded in the mid-1990s. Decisions made over the next few years will govern the ATF's future costs. And, again in turn, the nature and expense of that airplane will influence substantially the choices the Air Force and the Congress will face in the defense budget debates of the 1990s and beyond. Thus this airplane is an important budget issue now, even though it will not enter the force for a decade, and its current costs are only about $240 million in fiscal year 1986 and $260 million in fiscal year 1987 for research and development.

The following sections describe the timing of the ATF development, Air Force desires for increased capability and the sensitivity of the aircraft's procurement to different assumptions about cost increases. The chapter concludes by analyzing the effects the plane's cost could have on the Air Force's ability to maintain the size of its tactical forces.

DESIGN PROCESS TO DATE

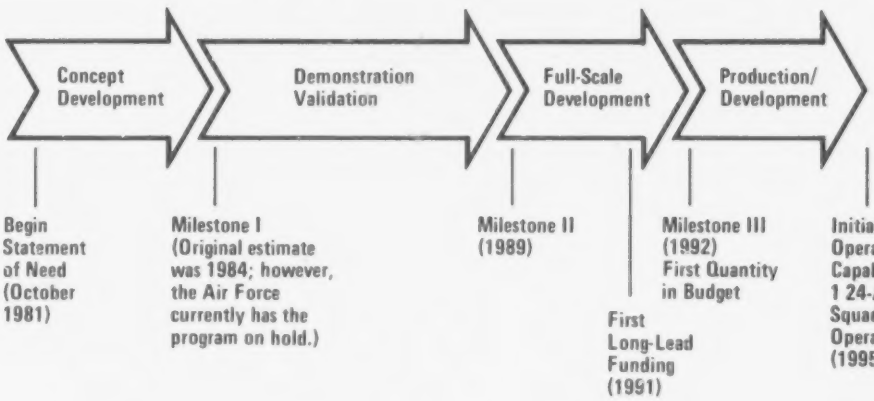
Aircraft development is a long process. It begins with a decision that a new aircraft is needed and progresses through stages that define what that new aircraft should be able to do and what it should look like. The length of that process, and the timing of key decisions, clarify the need for early Congressional participation in order to affect the eventual cost of the ATF.

Figure 7 shows the current development and production schedule for the ATF. The ATF is now approaching "Milestone I," which was to have occurred in 1984 but has been delayed within the Air Force secretariat for unspecified reasons. Before Milestone I is reached, the Air Force must

define a need for a new aircraft, describe which missions it is to accomplish, and broadly define which capabilities should be improved to justify new development. 1/ With these concepts in mind, the Air Force solicits ideas from industry about what kinds of aircraft might meet desires.

This solicitation is called a Concept Development Investigation (CDI) and the CDI for the ATF was dated May 1983. The Air Force received responses from seven major aeronautics companies in May 1984. 2/ Their responses showed tremendous variations in proposed designs. Informal

Figure 7.
Program Schedule for Advanced Tactical Fighter


Concept Development
Demonstration Validation
Full-Scale Development
Production/ Development
Begin Statement of Need (October 1981)
Milestone I (Original estimate was 1984; however, the Air Force currently has the program on hold.)
Milestone II (1989)
First Long-Lead Funding (1991)
Milestone III (1992) First Quantity in Budget
Initial Operating Capability– 1 24-Aircraft Squadron in Operation (1995)

SOURCE: Congressional Budget Office from U.S. Air Force.

1. Press reports have indicated that, when the ATF went to its initial review before the Air Force Systems Acquisition Review Committee (AFSARC) last fall, preparatory to going before the Defense Systems Acquisition Review Committee (DSARC Milestone I), the Secretary of the Air Force placed the project on hold until the service could identify what it intended to do about a replacement for the A-10 in its close air support mission. The Air Force is now working on a request for information for such a follow-on to the A-10. This request might go out this spring, at which point the ATF could go back into the hopper. At this point, however, projections for the ATF Milestone I would be highly speculative.

2. The seven companies that submitted proposals are: the Boeing Company, General Dynamics Corporation, Grumman Aerospace Corporation, Lockheed California Company, McDonnell Douglas Corporation, Northrop Corporation, and Rockwell International Corporation.

reports indicate, for example, that the weights of the proposed airplanes varied from 20,000 pounds to 110,000 pounds. By the time the Air Force reaches Milestone I and ends the concept development stage, many factors that influence the cost of the aircraft will be decided. For example, the Air Force will set a goal for the weight of the aircraft, and will specify a set of capabilities that it wants to attain. As the ATF moves through the development process, these key decisions that underlie the cost of the ATF will become increasingly difficult to change. Thus, even though initial operating capability is not expected until 1995, key decisions affecting costs and capability are occurring now.

CAPABILITIES DESIRED IN THE ATF

Early Air Force thinking about the ATF suggests that it wants a very capable plane. The Air Force is projecting that the increases in the threat described earlier in this report will continue. By the 1990s and early in the next century, the Air Force expects continued Soviet development and deployment of aircraft qualitatively superior to today's fighters. Additionally, the Air Force is concerned that the look-down, shoot-down radars of the new Soviet Flanker and Fulcrum aircraft, which can detect aircraft from above, would deny low-level penetration of U.S. aircraft when the new Soviet aircraft are deployed in quantity. It also expects that the Soviet's quantitative advantage, also discussed earlier, will continue to exist. Finally, the Air Force expects Soviet air defense assets to increase in capability. Thus, the Air Force feels that there must be major advances in the capability of the ATF to maintain the U.S. qualitative advantage.

Moreover, the Air Force believes that a group of new technologies would greatly enhance force performance. The service has not yet decided which of these technologies should receive highest priority or would be most fruitful to pursue, but contractors participating in the CDI process were instructed to consider the following:

Enhanced Avionics. The Air Force would like to improve the systems that assist the pilot to locate and attack targets. This is of particular importance if, as seems possible, the ATF will be a single-seat fighter. For example, one possible innovation would be voice-activated controls so that pilots could give commands without having to move their hands from the controls. Additionally, as Soviet radars become more capable, improvements to U.S. radars are needed to preserve the current U.S. advantage of seeing and attacking enemy aircraft before being seen and attacked themselves.

Stealth. The ATF could also be expected to incorporate stealth technology to reduce its radar signatures and thus its visibility to Soviet fighters and radars, as well as to reduce its heat emissions to make it less visible to infrared sensors. As surprise is a particularly important factor in tactical fighters, this trait could be very helpful. Very little unclassified information is available about what technologies make an aircraft "stealthy," but press reports have indicated that stealth is a broad-reaching family of technologies that would affect the shape of the aircraft and materials used to construct and coat it.[3] According to press reports, one particularly problematic area for the ATF might be the interface between the requirements associated with stealth and those of increasing its performance by including the avionics discussed above and supersonic cruise speeds discussed below. The former might cause problems because the radar emissions of the aircraft could announce its presence; the latter because, among other reasons, heating of the airframe at high speed could increase visibility to infrared sensors.

Supersonic Cruise Speeds. The Air Force would like the ATF to be able to fly faster than the speed of sound (Mach 1) for longer ranges than current U.S. fighters can. (Current fighters use afterburners which burn fuel at very inefficient rates; thus flight at high speeds rapidly depletes fuel reserves and is inherently limited. The Air Force would like the ATF to be able to fly at and above Mach 1 without the need of an afterburner, using so-called dry power.) The advantage of supersonic cruise speeds is an increase in the fighter's survivability and the timeliness of response to a crisis.

Longer Flight Ranges. The Air Force has long believed that one of the best places to attack planes is on the ground--either by bombing the planes themselves before they have a chance to take off or by damaging their air bases so that returning planes will have difficulty landing or being adequately supported for their next sortie. For many years, however, Soviet aircraft had fairly short flight ranges in comparison with those of U.S. planes and thus could not effectively destroy U.S. aircraft on the ground. With the introduction of the Sukhoi Su-24 Fencer in 1974, which has a combat radius above 1,000 statute miles, this qualitative edge appeared to have eroded. The Air Force expects this trend to continue, but is hoping to regain an edge by emphasizing longer flight ranges in the ATF to enable the aircraft either to be deployed from air bases farther from the air battle area or to fly farther into enemy territory. A particularly taxing theater of operations is Southwest Asia where bases available to U.S. aircraft could be located very far indeed from the targets that they are intended to attack.

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3. For a fairly comprehensive discussion of the family of technologies involved in stealth, see Bill Sweetman, "Stealth," *International Defense Review*, vol. 2 (1984).

Even if longer flight ranges were not needed in a particular battle, the same capability would allow the ATF to loiter longer times or carry higher payloads, both of which might prove to be desirable characteristics, especially if the Air Force decides to try to incorporate some air-to-ground capabilities in the ATF.

Short Take-Off and Landing (STOL). The increase in range in Soviet aircraft also has led to a desire for the ATF to be able to use less sophisticated or damaged airfields, which are useless for current aircraft. For example, the Air Force wishes the ATF to be able to take off and land on damaged runways, where only a portion of the length of the field might be available. The Air Force is investigating engines that have movable nozzles which can direct the thrust in different directions, and thus reduce the required usable runway length. The Air Force also hopes that this capability could be used in combat to enhance maneuverability.

Easy Maintainability and Higher Reliability. Obviously an aircraft that is in service more increases the overall capability of the force. Additionally, dispatching aircraft to austere airfields--which by definition do not have all of the maintenance facilities of main operating bases--would increase the need for airplanes that break down less frequently and that are easier to repair when they do. Additionally, the Air Force would like to reduce the ground support equipment typically needed simply to refuel and restart aircraft and turn them out for their next sortie. This would limit the time needed to move U.S. forces and their equipment to a crisis area.

Increased Survivability of Crew in a Contaminated Environment. Finally, the Air Force is concerned with Soviet advances in biological and chemical warfare and would like to be able to use its fighter aircraft after nuclear detonations have occurred. Hence, the Air Force would like a system for generating oxygen on board the aircraft. This capability would also be necessary if the aircraft ever needed to operate at altitudes over 50,000 feet for extended periods of time.

Although all of these wishes for increased capability are understandable, it is unlikely that they can be had without higher costs. Indeed, the Air Force expects ATF costs to exceed those of the F-15. Earlier informal conversations with the Air Force indicated that these increases might be only 15 percent more than the F-15 in real terms.

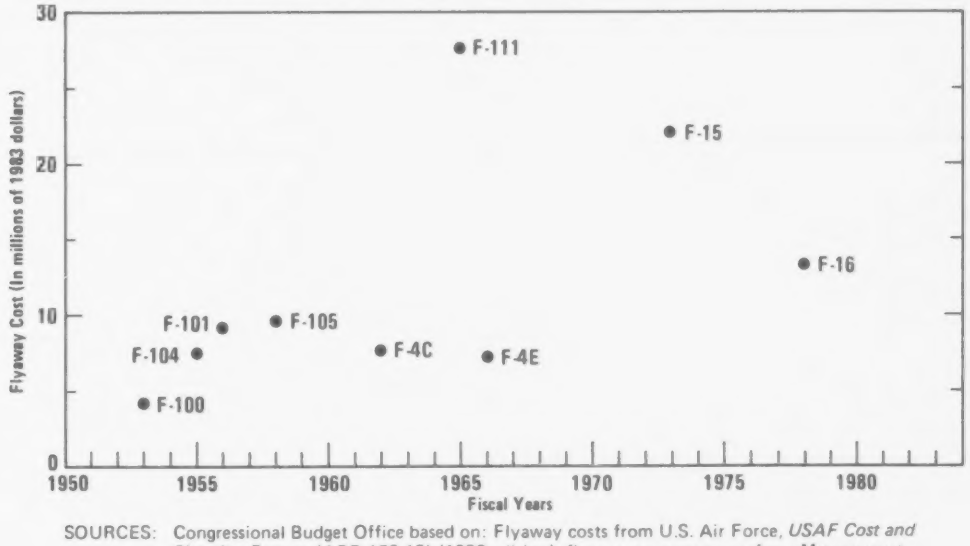
An Air Force study on ATF affordability, however, now appears to assume much larger increases.[4] That study assumes that the "flyaway"

4. Department of the Air Force Briefing, "Tactical Fighter Roadmap Affordability" (March 1985).

costs of each ATF (that is, aircraft costs excluding expenses for spares and ground support equipment) will be $40 million in 1985 dollars. As earlier indicated, total procurement costs are much higher. F-15 flyaway costs, as reported in the Air Force Cost and Planning Factors Manual, are about $25 million in 1985 dollars. This would suggest that the Air Force might be expecting the cost of the ATF to be about 60 percent higher than that of an F-15, at least for flyaway costs. Although the Air Force requested contractors to specify which design requirements would be most costly, most of the emphasis currently seems to be placed on increased capability. Thus even the larger cost estimate could be low.

Indeed, if history serves as a guide, cost increases could be much larger than 15 percent--or even 60 percent. Figure 8 shows the relationship between the flyaway costs of various generations of Air Force aircraft (the figure includes the F-4 which, though developed by the Navy, was procured by the Air Force in large quantity). The figure demonstrates that there is a good deal of divergence among increases. The smallest increase shown is that experienced by the F-16 over the most comparable previous fighter, the F-104. But, even though the F-16 was developed to be a low-cost aircraft, it was still 80 percent more expensive than the F-104. The largest cost increase shown here is from the F-105 to its follow-on, the F-111. The F-111 was 2.9 times the cost of an F-105. (All comparisons of flyaway costs

Figure 8.
Aircraft Flyaway Cost versus First Procurement Year



SOURCES: Congressional Budget Office based on: Flyaway costs from U.S. Air Force, *USAF Cost and Planning Factors* (AFR 173-13) (1983 edition); first procurement year from Management Consulting and Research, Inc., *U.S. Military Aircraft Cost Handbook* (March 1983).

are in 1983 dollars and are taken from the 1983 Air Force Regulation 173-13, USAF Cost and Planning Factors.)

EFFECTS OF COSTS ON FORCE SIZE

The cost of the ATF could have important effects on the ability of the United States to maintain and expand its tactical forces, just as the cost of aircraft procured today have an impact on how many wings the Air Force can buy and operate. In order to assess these effects, CBO projected how many wings the Air Force could procure by the year 2010--when the ATF will be in the force in large numbers--as a function of the cost of the ATF and other factors.

Key Assumptions

The analysis made several assumptions. First, CBO allowed for 3 percent real budget growth annually (in 1985 dollars) in the funds allocated to the aircraft procurement account for fighter/attack aircraft. Three percent approximates historical growth in gross national product (GNP) and so could approximate growth in long-run defense spending; actual real annual growth in weapons systems funds in the tactical aircraft procurement account, however, was only a little over 2 percent on average for the 20-year period of fiscal years 1964 through 1983. Because this is a key, but also highly uncertain, assumption, a later part of the chapter examines the effects of assuming annual budget growth of 1 percent and 5 percent.

Next, CBO made various assumptions about what percentage of procurement would actually be ATFs (a high-cost aircraft) and what percentage would be lower-cost aircraft. (This concept is discussed throughout this chapter as the force "mix" of high- and low-cost aircraft.) One guide to a likely percentage is the historical average percentage in the high-cost end (F-15s) of the force mix over the last 10 years--namely, about 34 percent. This figure has, however, varied tremendously in different years--from 67 percent at the height of F-15 (high-cost) production to 15 percent when the F-16 and the A-10 (low-cost planes) were being procured in quantity. Thus the paper considers several alternative levels.

Another key factor is the level of cost of the low-cost aircraft. Three levels were considered. The first assumed that the F-16 (as the low-cost part of the mix) was procured at its current procurement unit cost of $22 million (flyaway cost is about $15 million) and that there was no real growth in its cost as a result of model changes.. This is a lower-bound assumption, reflecting neither history (the F-16's cost has increased by

about 70 percent from 1980 to the present, as the A, B, C, and D versions of the aircraft have been procured) nor Air Force plans for the fighter, which include an ongoing modification program and a major model change (both expensive). Thus CBO analyzed a second option that provided for 3 percent annual real growth in the cost of the F-16. Finally, since the ATF is required, according to the Air Force, because of expected leaps in the capability of Soviet aircraft, CBO analyzed the effect of procuring the F-15 (another very capable plane) as the low-cost end of the mix. The combination of the F-15 and ATF as the force mix would provide a very capable--and very expensive--tactical air force.

Effects on Force

The analysis shows that only under a few assumptions which seem quite unrealistic could the Air Force hope to buy today's number of 36 wings or more while acquiring the ATF (see Table 9). It would have even less chance of expanding to 40 or more wings as it hopes to do.

If, for example, the cheaper aircraft that is bought along with the ATF is an F-16 that experiences no real cost growth, then the Air Force would have a reasonable chance of buying 36 or more wings. But the Air Force has already announced plans for the F-16 that are likely to increase its costs. If the less expensive plane is an aircraft that grows in cost at a real rate of 3 percent a year above the cost of today's F-16, then the Air Force could buy about 36 or more wings only if it is able to limit ATF costs to 50 percent more than the cost of the current F-15 (approximately reflecting recent Air Force projections), and then only if it buys about 22 percent ATFs (about the same fraction of high-cost F-15s in the fiscal year 1986 budget). Moreover, limiting cost growth for a new generation of fighters to 50 percent has not been achieved in recent history and probably is not consistent with the long list of improvements in capability, noted above, which the Air Force hopes to incorporate in the ATF.

Under more plausible assumptions, the Air Force probably could afford only a force of fewer than 36 wings. For example, if the low-cost aircraft in the mix is an F-16 that grows in cost at 3 percent a year, and the ATF ends up costing twice as much as the current F-15 in real terms, then the Air Force could buy only 29 wings, assuming--as has been the case in the past for the high-cost plane--that the ATF makes up about one-third of the total number of aircraft.

Under assumptions that are not far-fetched, the Air Force could face an even more substantial reduction in the numbers of wings it could buy. Assume, for example, that the lower capability aircraft ends up costing the same as an F-15, perhaps not an unrealistic assumption given the projected

improvements in Soviet aircraft and U.S. attempts to maintain superior capability. Assume, moreover, that the ATF makes up one-third of tactical air force annual procurement as the higher-quality aircraft have in the past. If the ATF were to cost twice the current price of the F-15, the Air Force could buy only 26 wings. If the ATF were to cost three times what the F-15 now costs, a ratio similar to the jump in costs between the old F-4 and the F-15, then the Air Force could buy only 23 wings.

These results consider only the costs of procuring new aircraft. Costs for operating and support of the ATF are impossible to estimate at this point, given the lack of a specific design. But historical operating and support costs have experienced the same 3 percent real growth assumed

TABLE 9. IMPACT OF ATF COST AND OTHER FACTORS ON THE SIZE OF THE TACTICAL AIR FORCES THROUGH 2010, WINGS SUPPORTED BY FUNDED DELIVERY PERIOD, 3 PERCENT REAL BUDGET GROWTH

Percent of ATF in Forces	Cost Growth in Three Alternative Lower-Cost Aircraft	Number of Wings Based on ATF/F-15 Cost Ratio		
		1.50 (Approximate AF Projection)	2.0 (F-16/F-4 Cost Ratio = 1.7) [a]	3.0 (F-15/F-4 Cost Ratio = 2.8) [b]
22 [c]	F-16, no growth	46 [d]	40 [d]	33
	F-16, 3% annual	35	32	27
	F-15, no growth	30	28	25
34 [e]	F-16, no growth	40 [d]	34	26
	F-16, 3% annual	33	29	24
	F-15, no growth	29	26	22
75	F-16, no growth	28	23	17
	F-16, 3% annual	26	22	17
	F-15, no growth	25	21	16
100	All ATFs	24	19	15

SOURCE: Congressional Budget Office.

a. Historical cost ratio of low-cost aircraft in tactical forces mix to preceding air superiority aircraft.

b. Historical cost ratio of high-cost aircraft in tactical forces mix to preceding air superiority aircraft.

c. Programmed percentage of F-15s to total Air Force fighter/attack procurement in DoD Five-Year Defense Plan for fiscal year 1986.

d. Above or equal to current force size.

e. Percentage of higher capability aircraft in Air Force procurement over the last 10 years.

here for the procurement account. If this trend were to continue, the operating and support (O&S) account could provide no savings to offset budgetary problems caused by the ATF's potentially high procurement costs. The Air Force is, indeed, hoping to reduce the ATF's O&S costs below those of the F-15, but it is too soon to tell whether this expectation will materialize. It might, however, be inconsistent with the desired improvement in aircraft capability that, at very best, is likely to drive up costs of replacement spare parts.

Alternative Budget Growth

The results discussed above could change considerably if the tactical air budget receives more or less than the 3 percent annual growth assumed above. If, for example, the tactical air budget gets only 1 percent annual growth, no combination of assumptions would maintain today's force levels and most assumptions would lead to sharply lower levels. (Table C-1 in Appendix C shows a version of Table 9 that assumes 1 percent annual budget growth.) Because such reductions in force levels are unlikely to be acceptable in the face of the anticipated threat, this alternative suggests that, even if ATF costs are held down, pressure will develop for substantially higher tactical aircraft budgets during the next decade.

If 1 percent annual budget growth essentially precludes expansion and perhaps even maintenance of today's force levels, 5 percent annual growth makes expansion quite feasible. For example, assuming 5 percent annual real growth in fighter funding, 38 tactical fighter wings--two more than today's level of 36--could be bought even if the ATF were to cost twice as much as the F-15 and the Air Force chose to buy today's level (about 34 percent) of the high-cost fighters. (Table C-2 in Appendix C shows detailed results.) Indeed, a recent Air Force study on the affordability of the ATF reached sanguine conclusions partly because it effectively assumed large annual growth in tactical air budgets. [5] (The Air Force study also assumed that the costs of an F-16 would decrease by about 22 percent and those of an F-15 by about 33 percent. In addition, it assumed that the total ATF unit procurement cost would be only about 20 percent higher than that of the F-15. These assumptions contributed so much real growth to the tactical air force budget that the Air Force concluded that the ATF would be affordable.)

Five percent annual real growth might be quite unlikely, however. It seems very improbable that the overall defense budget will grow at that level for a decade more; it has not sustained such growth for a decade

5. Ibid.

anytime in the postwar period. Thus such growth would require increasing the Air Force's share of the total defense budget or the share that the tactical air force receives of the Air Force's budget. Given the many competitors for the money, ranging from sustaining the 600-ship Navy to strategic improvements and space activities, such increases in share would at best be difficult to achieve. 6/

CONGRESSIONAL ACTION

Considering the crucial importance of the ATF's cost to future force levels, what, if anything, should the Congress do at this early stage of ATF development? Most current emphasis is placed on capability increases and complex engineering considerations that are difficult for the Congress to monitor. Moreover, at least one Member of the Congress has expressed a desire to avoid intruding extensively in development efforts by the DoD. 7/

The Congress might, however, wish to require an annual report on the likely future cost of the ATF. As the program progresses, it could require that these future cost estimates be reviewed by cost analysts of the Office of the Secretary of Defense to be sure that they follow acceptable cost estimating procedures. If the projected cost exceeded a percent limit, the Congress could require clear explanations of the cost increases and an Air Force plan for reconciling the more costly ATF with the maintenance of reasonable force levels. The limit might initially be set at 60 percent above the cost of the F-15, the increase apparently forecast in the recent Air Force study. That limit is conceivably consistent with maintaining today's force structure--though not with achieving more wings--if the Air Force receives 3 percent annual increases in its tactical air budget and does not buy many ATFs. (If ATF cost increases grew well above 60 percent, major changes in the share of the budget accorded to tactical aircraft, or in the Air Force's overall budget, would be needed just to maintain today's force structure.)

Such a cost cap might raise the priority of monitoring cost in the ATF design without requiring regular or detailed management by the Congress. A cost cap does risk stifling the search for needed improvements in tech-

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6. See Congressional Budget Office, *Future Budget Requirements for the 600-Ship Navy: Preliminary Analysis*, Staff Working Paper, April 1985.

7. Paul Mann, "Key Senator Seeks Arms Project Curb," *Aviation Week and Space Technology* (March 4, 1985).

nology to meet future threats. But such improvements are already a high priority in the Air Force and in the defense industry and, therefore, might not be affected. Moreover, the cap would not lessen pursuit of such technological innovations so long as a case could be made that they were worth the likely expense. Clearly, this is only one possible method for dealing with the problem of ATF cost. The Congress could also intervene through the normal legislative channels of hearings and reports.

Whatever the Congress chooses to do, it is clear that the cost of the ATF will have an important effect on the budget choices that the Administrations and Congresses of the 1990s will face. It is also clear that, if the Congress wishes to exercise control over ATF costs, it would be easier to do so now--at the early design stages--before the changes needed to hold down costs will involve expensive engineering modifications.

APPENDIXES

APPENDIX A

STRATEGIC MODERNIZATION AND ITS IMPACT ON THE TACTICAL FORCES

Modernization of the strategic forces has been the centerpiece of this Administration's plans for defense improvement. An important part of this modernization program has been improvement to the strategic offensive bomber forces--specifically the procurement of 100 B-1B bombers by the late 1980s and the development of the Advanced Tactical Bomber (ATB) to begin deployment in the early 1990s. These additions will enable the Air Force to retire some of its older strategic bombers.

A second--less visible--aspect of the Administration's plans for strategic modernization involves enhancements to the so-called "strategic defensive forces," which are intended to defend the continental United States from attack by Soviet bombers. Among these improvements is the modernization of 15 fighter/interceptor squadrons with F-15 and F-16 aircraft.

Changes to each of these programs could affect the tactical air forces and this appendix discusses the impact of such changes.

STRATEGIC OFFENSIVE AIRCRAFT

As indicated earlier in this paper, both major tactical aircraft improvements planned by the Air Force for the 1980s--F-15E and F-16F--are related to improving Air Force performance in the deep interdiction mission. Should budget constraints reduce procurement of either of these aircraft, transfer of older strategic bombers, which current plans would retire, might augment the tactical forces' bombing inventories for the deep interdiction mission. This section of Appendix A presents a brief analysis of one such possible transfer.

Transfer FB-111 to Tactical Air Command

Three hundred-twenty F-111 aircraft currently comprise the long-range, low altitude, bad weather inventory that is the backbone of the Air Force deep interdiction forces. F-15E procurement, described earlier in this paper, is intended to augment these forces, even though the F-15E will have a somewhat shorter range than the F-111. Indeed the F-111 is considered by the

Air Force to be such a capable aircraft that it will be retained in the tactical inventory well into the 1990s--long after 20 years of service life will have passed for the aircraft. Seventy-six FB-111s were procured for the Strategic Air Command (SAC), and of these 56 are still in SAC's inventory. FB-111s are slightly larger than F-111s but are very comparable--for example, having a variant of the T-30 engine which is used in the F-111. Additionally, SAC's FB-111 inventory is about the same age as the F-111s in the Tactical Air Command (TAC). SAC intends to begin retiring its FB-111s in 1992--reducing the force from 56 to 30--and to eliminate them completely by 1993.

The Congress has repeatedly expressed an interest in the possibility of transferring these 56 SAC FB-111s to TAC. Most recently the House Appropriations Committee, in its report on the fiscal year 1985 budget, requested that the Air Force consider the effect of such a transfer--as well as a transfer of B-52s--on the tactical air forces. If budget pressure should cause F-15E procurement to be reduced, as was discussed in Option II in the body of the paper, it might be possible to transfer FB-111s to TAC as much as five years earlier than the Air Force's current retirement date of 1992. By 1988 all the B-1Bs would have entered the force, thus lessening SAC's need for the FB-111s.

The costs of such a move would be negligible to the Air Force as a whole. Some savings might even accrue, as the same aircraft would have been operated by SAC, which has higher flying hour profiles for the F-111 than does TAC, and flying hours have a direct impact on operating costs. Increased costs to TAC could be substantial, however, because the operation and support (O&S) costs associated with 56 FB-111s (in fiscal year 1984 dollars) would be about $200 million annually. Obviously if flying hours were reduced, these costs would also be reduced.

For TAC, the increase in potential capability, as measured by the TASCFORM model, would be about 2 percentage points higher by 1992 than in Option II in Chapter III--bringing it to a 30 percent improvement, or within 2 percentage points of the 32 percent improvement yielded by the Administration's program. The option would, however, reduce SAC's bomber assets, albeit only for the short period of time before the FB-111s would have been retired in any case. This study cannot quantify that loss.

STRATEGIC DEFENSE AIRCRAFT

The main body of this paper focuses on tactical general purpose forces and excludes aircraft to modernize 15 fighter/interceptor squadrons intended to

defend the United States from attack by Soviet strategic bombers (CONUS air defense). Four of these strategic squadrons are in the active forces. 1/ The desire to modernize these strategic forces formed the primary justification for initial F-15 procurement. The Air Force intends to modernize the four active CONUS air defense squadrons with F-15s in the late 1980s. An additional mission associated with these squadrons is the antisatellite attack (ASAT) role, in which they would attack Soviet satellites with missiles launched from F-15s. Two squadrons, at McChord and Langley Air Force bases, are intended to perform this role.

The remaining 11 squadrons belong to the Air National Guard (ANG) and, under Air Force plans, are to be modernized by 1992 with F-16s. This modernization would absorb some purchases of F-16s. For purposes of the analysis of the Administration's option in the main text, CBO assumed that modernization of strategic defense forces occurred on the schedule shown in Table A-1.

TABLE A-1. CUMULATIVE NUMBER OF SQUADRONS FROM AIR DEFENSE FORCE MODERNIZATION PLAN (By fiscal year, in number of squadrons modernized)

Aircraft	1985	1986	1987	1988	1989	1990	1991	1992
F-15 (Active)	2	3	4	4	4	4	4	4
F-16 (Air National Guard)	0	0	2	5	5	6	10	11

SOURCE: Congressional Budget Office.

1. The Air Force currently has 16 fighter/interceptor squadrons--five active squadrons and 11 reserve squadrons--but the service plans to reduce the number of active squadrons to four within the next several years.

As an alternative, the Air National Guard air defense squadrons could be modernized by modifying existing F-4 aircraft and moving fewer F-16 aircraft into the strategic mission. As far as procurement rates are concerned, this alternative is identical with Option III in Chapter III. Under this approach, however, the modified F-4E aircraft would be placed in the 11 air defense squadrons, while F-16s would go to the general purpose forces.

The costs of this alternative would be essentially the same as those for Option III. Moreover, the effects on the potential capability for the general purpose forces would be about the same as was estimated under Option III, even though these forces now receive F-16s rather than modified F-4Es. This occurs because the TASCFORM model accords similar scores to F-16A/Bs and modified F-4Es.

But this version of Option III might still be reasonable because the CONUS air defense mission might be the most logical place in which to retain older F-4s. 2/ The Guard believes this for several reasons. First, the mission itself might be more readily suited to older aircraft. In the CONUS air defense mission, incoming Soviet bombers would be detected first by a boundary of radars, and then AWACS aircraft (distant early warning planes) would refine information about bomber locations. Finally, fighter aircraft would be vectored to intercept the bombers (which, at that range from their home bases, could not be accompanied by enemy fighters). The bombers then would be shot down by medium-range missiles. Because in this mission it is generally assumed that the interceptors would not become involved in a free wheeling air battle--a dog fight--they would not experience the high gravitational forces which an aircraft in a dog fight might be expected to undergo. Because it is exactly these stresses to the airframe that could have the most impact on the survivability of the older aircraft, the interceptor mission could allow older aircraft to remain capable in service for longer times.

Second, until the advanced medium-range air-to-air missile (AMRAAM) is fielded, the F-4 might be more capable in the air defense

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2. Which aircraft the Air National Guard actually desires for its fighter/interceptor squadrons has been the source of some confusion recently. The National Guard Association, which, in general, lobbies the Congress in support of Guard goals, sent a newsletter (a so-called actiongram) to its members on February 11, 1985 instructing them to support procurement of the F-20 Tigershark, a variant of the F-5 by produced by Northrop Corporation, for the CONUS defense mission. The intent apparently was to try to get the Congress to supply additional funds above those requested in the fiscal year 1986 budget, for this procurement. This presumably implies that the National Guard would prefer F-20 procurement to F-4 improvement, though the Guard is still interested in some F-4 modification.

mission than the F-16, because it can fire the Sparrow medium-range radar missile, which the F-16 cannot. Additionally until AMRAAM inventories are built up, it is likely that deliveries of the missile would go to the active forces; therefore, the Guard's F-16s might continue to lack a radar missile capability for a long time after AMRAAM is fielded with the active forces.

APPENDIX B

MODEL METHODS

The analysis in the main body of this paper and Appendix A depends largely on two models, each of which is discussed in detail here. The first model provides projections of Air Force aircraft inventories. The second model is the Technique for Assessing Relative Force Modernization (TASCFORM) model, which provides estimates of merit for the alternatives considered in the paper.

AIRCRAFT INVENTORY MODEL

Projecting aircraft inventories requires a model that accounts for numerous details of Air Force plans. The CBO developed such a model, using the assumptions discussed below.

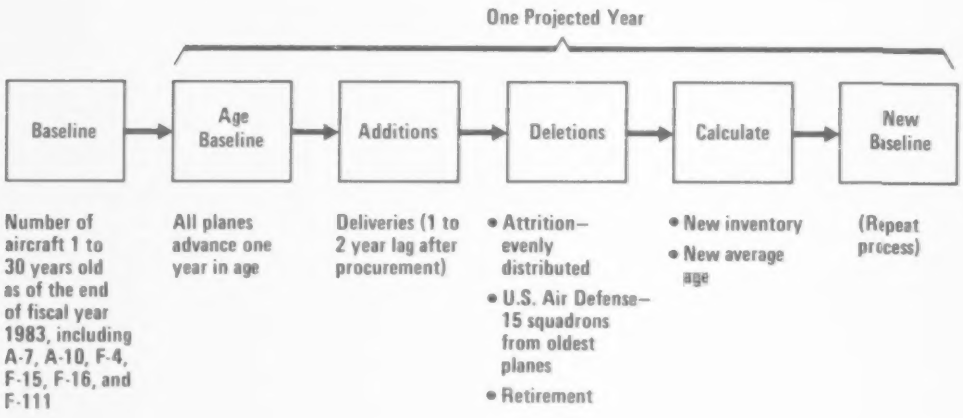
The model starts with an inventory of tactical air force fighter/attack aircraft as of the end of fiscal year 1983, provided by the Air Force (see Figure B-1). To this baseline, aircraft deliveries, dependent upon procurement schedules, are added. Air Force delivery schedules, which lag about two years behind procurements, were used. Several kinds of deletions from the inventory are then made. First, in any year, the Air Force can expect to lose aircraft because of accidents; in fiscal year 1984, for example, 37 fighter/attack aircraft were lost. Planning factors from the Air Force, based upon hypothesized flying levels (also from the Air Force), were used to delete these "attrition" losses. 1/

1. There is some controversy over whether the attrition rates that the Air Force uses are accurate or not. Over the past several years, the General Accounting Office (GAO) has published several reports indicating that averaging historical attrition rates, as the Air Force has done, captures the higher attrition rates typically associated with the early years of introduction of an aircraft to the fleet, thus inflating the rates when they are applied to mature aircraft. As attrition forms a relatively small portion of those factors influencing the inventory, and as the results of this analysis are fairly insensitive to small changes to them, CBO accepted the Air Force planning factors. For more in-depth information on the subject, see Statement of Werner Grosshans, GAO, Planning Director, National Security and International Affairs Division, before the Subcommittee on Legislation and National Security, House Committee on Government Operations (June 2, 1983); and Report to the Congress by the Comptroller General of the United States, *The Congress Should Require Better Justifications of Aircraft for Noncombat Missions* (July 22, 1980).

Second, as the inventory also includes aircraft for strategic defense interceptors, these aircraft are deleted to meet the Air Force's expressed goals for modernization of those forces. Specifically, the Air Force has indicated that it intends its strategic interceptor force to be composed entirely of F-15 and F-16 aircraft by the early 1990s. There are currently 16 squadrons, with 18 aircraft each, in the strategic force. But because the Air Force intends to deactivate one active squadron within the next year or so, CBO assumed that there would be 15 squadrons--four active and 11 reserve. The Air Force intends to modernize its active squadrons with F-15s and its reserve squadrons with F-16s. For the purposes of this analysis, enough F-15s and F-16s to modernize these squadrons were removed from the inventory on the basis of a schedule that was kept constant for all alternatives. This modernization schedule could be slowed, as was discussed in Appendix A, should procurement be reduced.

Finally, aircraft are deleted based upon the assumed retirement age; this age was varied in some of the options to meet force requirements. According to the Air Force, aircraft are retired either because of obsolescence in face of the threat or because of structural fatigue. As a general principle, the Air Force would like to retire aircraft at 20 years of age, although projected structural service lives for most aircraft far exceed this goal. For example, the F-4E, which has been in the fleet for an average of

Figure B-1.
Method Used for Aircraft Inventory Model


One Projected Year
Baseline
Age Baseline
Additions
Deletions
Calculate
New Baseline
Number of aircraft 1 to 30 years old as of the end of fiscal year 1983, including A-7, A-10, F-4, F-15, F-16, and F-111
All planes advance one year in age
Deliveries (1 to 2 year lag after procurement)
• Attrition–evenly distributed
• U.S. Air Defense–15 squadrons from oldest planes
• Retirement
• New inventory
• New average age
(Repeat process)

SOURCE: Congressional Budget Office.

15 years, has about 17 years of service life remaining. Thus, if the F-4E were retired on the basis of structural fatigue, it would be retained until it was over 30 years old. For options with too few aircraft to meet force requirements, it was assumed, therefore, that F-4s could be retained longer than 20 years. For example, for the Administration's program, F-4s were retained an average of about a year longer.

All these additions and deletions translate the baseline at the end of 1983 into an estimate of strength at the end of fiscal year 1984 (the new "end-strength"). This procedure was repeated for each year through the year 2000.

The model also calculates the average age of the fleet. 2/ The Air Force has used average age as a proxy for capability, indicating that it would prefer to keep the average age of the inventory at no more than 10 years. This is simply a different way of looking at the 20-year retirement goal discussed earlier. This proxy was included in the analysis to display any aging effects associated with the different options.

TECHNIQUE FOR ASSESSING RELATIVE FORCE MODERNIZATION MODEL

Chapters I and III and Appendix A used quantitative indexes of relative force modernization to compare the potential capability of the alternative forces considered. To quantify tactical aircraft potential capability, CBO relied on the TASCFORM model, developed by The Analytic Sciences Corporation (TASC) for the Office of the Secretary of Defense, Net Assessment.

The potential capability of tactical air forces depends in part on the number of each type of aircraft in the force; each aircraft's performance characteristics, including airframe performance, avionics, and armament; and the importance of these performance characteristics in achieving the aircraft's designated missions, which include close air support, inderdiction, and fighter/interceptor.

While CBO's model projects tactical aircraft inventories, the TASCFORM model provides quantitative measures for each type of aircraft's performance characteristics. The following is a discussion of how

2. The calculation of average age assumes that aircraft are at the midpoint of their age "cell." Thus aircraft that are between zero and one years of age at the end of a year are assumed to be one-half years old.

the TASC numbers were derived and how they were used. (See box on page 38 of Chapter III for an outline of the steps in the methodology.)

TASCFORM Methodology

First, TASCFORM computes each aircraft's airframe performance (AP) by comparing the capabilities inherent in its airframe and engines to those of the F-4B. The factors initially considered are payload, range, maneuverability, and speed. The factors are not equally important to all missions and the TASC models weights them differently for different roles. More emphasis is placed on payload in close air support, for example, while in the fighter/interceptor mission characteristics like speed receive more emphasis. TASCFORM thus produces multiple APs for aircraft capable of performing more than one mission by weighting these factors according to their relative importance in each mission.

Next, TASCFORM adjusts the aircraft's scores for improvements in the weapons systems it can carry and its avionics equipment, which enable the aircraft to find and destroy its target. Adjustments here, for example, would reward an aircraft for advances in missile capability or improvements in targeting pods. The model also adjusts the scores for the survivability of the aircraft, reflecting, for example, whether the plane carries countermeasures to decoy radar and infra-red missiles. The result is an Aircraft System Performance (ASP) figure for each mission.

The system performance figures are then adjusted to reflect the number of sorties the plane can perform. This adjustment produces the figures shown for selected aircraft in Table B-1. To derive a single performance figure for an aircraft, TASCFORM averages the mission scores, weighting each for the fraction of time the aircraft is to spend in each mission.

Finally, TASCFORM "depreciates" these total scores; the model successively reduces the score each year after the aircraft first enters the inventory. Depreciation captures the deteriorating effect of age on aircraft performance. CBO multiplied the depreciated scores for 1992 by the inventory projections of the CBO model for that year to produce a capability figure for the whole inventory.

Limitations to the Model

TASCFORM does not predict combat outcomes. It provides static indicators of performance potential rather than dynamic measures of

effectiveness. As the outcome of a battle is as likely to be affected by performance potential of its pilots as of its aircraft, as well as other factors, TASCFORM could be said to overemphasize hardware.

Additionally, the model is based upon the subjective assessments of the individuals involved in the initial survey research project. Although TASC solicited the opinions of a wide variety of pilots and analysts, in a field as divisive as tactical air forces, individual assumptions about the relative importance of different performance aspects inevitably will be open to dispute.

Finally, TASCFORM also combined scores for multiple different performance aspects, for multiple different roles, and at the highest level of aggregation, for multiple different aircraft to produce a single score. This

TABLE B-1. TASCFORM ADJUSTED AIRCRAFT SYSTEM PERFORMANCE (AASP) FIGURES FOR SELECTED AIRCRAFT a/

Aircraft	Close Air Support	Interdiction	Fighter/Interceptor
A-7	16.6	15.4	--
A-10	17.3	--	--
F-4 C/D	8.3	7.9	9.8
F-4E	10.4	11.2	11.4
F-4E Option IIIA	18.4	15.0	16.7
F-4E Option IIIB	17.7	14.4	16.1
F-4G	--	17.4	--
F-111	25.1	21.4	--
F-15 A/B	--	--	15.7
F-15 C/D	--	--	20.3
F-15 E	32.3	24.9	24.7
F-16 A/B	19.3	16.9	14.2
F-16 C/D	19.3	17.3	14.0
F-16 F	28.7	24.4	20.3

SOURCE: Congressional Budget Office estimates based on The Analytic Sciences Corporation data.

a. AASP figures are not calculated for missions the aircraft is not expected to perform.

is, in part, a strength of the model in that it enables a fairly simple comparison. It is, however, also a weakness in that it oversimplifies the issues involved in aircraft capabilities--an inherently complex and situational area.

APPENDIX C

IMPACT OF ATF COST AND OTHER FACTORS ON THE SIZE OF THE TACTICAL AIR FORCES THROUGH 2010 AT ALTERNATE GROWTH PERCENTAGES

The two tables in this appendix alter the number of wings that can be procured through 2010 by assuming different rates of real growth in the tactical air forces' budget. Table C-1 assumes 1 percent real growth, and Table C-2 assumes 5 percent real growth.

TABLE C-1. IMPACT OF ATF COST AND OTHER FACTORS ON THE SIZE OF THE TACTICAL AIR FORCES THROUGH 2010, WINGS SUPPORTED BY FUNDED DELIVERY PERIOD, 1 PERCENT REAL BUDGET GROWTH

Percent of ATF in Forces	Cost Growth in Three Alternative Lower-Cost Aircraft	Number of Wings Based on ATF/F-15 Cost Ratio		
		1.50 (Approximate AF Projection)	2.0 (F-16/F-4 Cost Ratio = 1.7) [a]	3.0 (F-15/F-4 Cost Ratio = 2.8) [b]
22 [c]	F-16, no growth	34	30	25
	F-16, 3% annual	27	25	21
	F-15, no growth	23	21	19
34 [d]	F-16, no growth	30	25	20
	F-16, 3% annual	25	22	18
	F-15, no growth	22	20	18
75	F-16, no growth	21	18	14
	F-16, 3% annual	20	17	13
	F-15, no growth	20	17	13
100	All ATFs	18	15	12

SOURCE: Congressional Budget Office.

a. Historical cost ratio of low-cost aircraft in tactical forces mix to preceding air superiority aircraft.

b. Historical cost ratio of high-cost aircraft in tactical forces mix to preceding air superiority aircraft.

c. Programmed percentage of F-15s to total Air Force fighter/attack procurement in DoD Five-Year Defense Plan for fiscal year 1986.

d. Percentage of higher capability aircraft in Air Force procurement over the last 10 years.

TABLE C-2. IMPACT OF ATF COST AND OTHER FACTORS ON THE SIZE OF THE TACTICAL AIR FORCES THROUGH 2010, WINGS SUPPORTED BY FUNDED DELIVERY PERIOD, 5 PERCENT REAL BUDGET GROWTH

Percent of ATF in Forces	Cost Growth in Three Alternative Lower-Cost Aircraft	Number of Wings Based on ATF/F-15 Cost Ratio		
		1.50 (Approximate AF Projection)	2.0 (F-16/F-4 Cost Ratio = 1.7) [a]	3.0 (F-15/F-4 Cost Ratio = 2.8) [b]
22 [c]	F-16, no growth	63 [d]	55 [d]	44 [d]
	F-16, 3% annual	47 [d]	43 [d]	36 [d]
	F-15, no growth	40 [d]	37 [d]	32
34 [e]	F-16, no growth	54 [d]	45 [d]	35
	F-16, 3% annual	44 [d]	38 [d]	31
	F-15, no growth	39 [d]	34	29
75	F-16, no growth	37 [d]	30	22
	F-16, 3% annual	35	28	21
	F-15, no growth	34	28	21
100	All ATFs	31	25	18

SOURCE: Congressional Budget Office.

a. Historical cost ratio of low-cost aircraft in tactical forces mix to preceding air superiority aircraft.

b. Historical cost ratio of high-cost aircraft in tactical forces mix to preceding air superiority aircraft.

c. Programmed percentage of F-15s to total Air Force fighter/attack procurement in DoD Five-Year Defense Plan for fiscal year 1986.

d. Above or equal to current force size.

e. Percentage of higher capability aircraft in Air Force procurement over the last 10 years.